Measuring Dispersed Use and Visitor Preferences on BLM Lands

Ross Arnold

FINAL REPORT

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"Measuring Dispersed Use and Visitor Preferences on BLM Lands"

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ABSTRACT OF THE
FINAL REPORT

"Measuring Dispersed Use and Visitor Preferences on
BLM Lands"

(16-721-CA)

The primary purpose of this study was to develop a procedure to estimate sample sizes for future Colorado State Comprehensive Outdoor Recreation Plan (SCORP) demand surveys which would produce reliable information describing recreation participation on Bureau of Land Management (BLM) Public Land. Maximum and minimum sampling levels were estimated utilizing two survey designs in each of two study areas (Gunnison and Rio Blanco Counties) in Colorado. The first survey design employed a roadside traffic-stop survey technique to sample recreation participation of visitors to each study area who live in locations outside the study sites. A household survey technique was used to measure the recreation participation of residents living in each study area.

Analysis of the recreation participation data collected in each study area from both survey techniques provided: (1) sample data summary statistics describing recreation participation in each study area; (2) estimates of total recreation use in each study area; and (3) precision and confidence levels for the recreation participation estimates. Overall, Gunnison County exhibited higher levels and more diversity of recreation participation than Rio Blanco County.

The statewide sampling levels were calculated from the total use estimates determined for each study area. Sample sizes were estimated

for three precision levels (±50%, ±25%, and ±10% of the estimates) at each of two alpha levels of confidence (.1 and .2). Results of this analysis indicate that the sampling levels of future Colorado SCORP demand surveys will have to be very large to provide reliable information useful for planning and managing recreation on Public Land.

Conclusions based on the results of this study imply: (1) the BLM must play an active role in the SCORP demand survey process by defining the agency's needs for recreation participation data in Colorado, and (2) the SCORP demand survey process might not be a practical, feasible, or reliable technique for collecting optimum recreation participation information useful to the BLM.

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CHAPTER I. INTRODUCTION

Most types of outdoor recreation use have experienced increasing numbers of participants during the last several decades. This growth is expected to continue based on changes in the factors which influence demand for outdoor recreation. These factors include: increased population, greater mobility, more leisure time, improved access to recreation areas, and better information specifying where to go and what to do (USDA 1977).

The growth in recreation participation and the mandates specified in recent Congressional legislation[1] increase the planning and management responsibilities of government agencies administering public lands. Knowledge is needed to develop sound planning for proper resource allocation decisions (USDA 1979). As the planning and management functions of the agencies increase, the need for data and the analytical tools necessary for decision making grows (Kolter and Gosse 1969).

One source of data available to recreation planners and managers in field locations is the recreation participation information in State Comprehensive Outdoor Recreation Plans (SCORP). Each state is required by the Heritage Conservation and Recreation Service (HCRS) to prepare periodic SCORP's to maintain eligibility for Land and Water Conservation Funds. These funds are administered by the HCRS to aid the states in

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[1]Examples of recent legislation defining the roles of specific agencies are: (1) the Forest and Rangeland Renewable Resources Planning Act of 1974 (FS/RPA; PL 93-378); (2) The National Forest Management Act of 1976 (FS/NFMA; PL 94-588); and (3) The Federal Land Policy and Management Act of 1976 (BLM/Organic Act; PL 94-597) (Francis 1978)

planning and managing for outdoor recreation. The assessment of needs describing the differences between projected demand and available supply is a major part of the SCORP. A major component of projecting demand for outdoor recreation is the identification of the existing recreation participation. Some states use a statewide recreation participation study to describe the current situation. The data collected from these surveys are available to the land management agencies in each state. According to State Recreation Planners in Michigan (Michigan Department of Natural Resources 1977), most of the data collected during the state surveys are inadequate for making planning and management decisions. Therefore, agencies attempting to use the recreation participation information from SCORP's face the problem of determining the reliability and applicability of those data to their planning needs. This research will develop one methodology for providing agency input into the recreation participation demand surveys implemented as part of the SCORP process. By incorporating the agencies' needs into the design of the SCORP demand survey, the data provided by those surveys will be more useful for planning and managing outdoor recreation on all public lands in each state.

Justification and Evolution of the Research

In February, 1976, a memorandum from the Chief, Division of Recreation in the Washington Office of the Bureau of Land Management (BLM), was formulated to prioritize those types of recreation research which would benefit BLM managers the most. That memorandum was based on input from BLM field managers. The recreation research project leaders at the Forest Service Experiment Stations were invited to submit research proposals relating to the seven research needs expressed in the memorandum.

It was clear that in designing the proposals, the State BLM offices should be contacted first to ascertain if the proposals were consistent with the State office's priorities and needs.

In the spring of 1976, Drs. B. L. Driver (Rocky Mountain Forest and Range Experiment Station) and Perry J. Brown (Colorado State University) met in the State Director's Office of the BLM in Colorado with Gene Miller, State Recreation Planner. At that time Miller indicated that the measurement of dispersed recreation use on the BLM Public Land (priority 1 on the Washington Office memorandum) was the most important need in that State Office. Specifically, Miller was interested in testing the feasibility of using Colorado SCORP demand surveys to acquire the dispersed use statistics needed by managers of the Public Land. Relating to this objective, two major questions were raised during that meeting and subsequent meetings:

(1) How accurate is the demand data from the 1973 Colorado SCORP survey for describing recreation participation on Public Land?

(2) If future Colorado SCORP demand surveys are implemented, what statewide sample size levels would be necessary to produce recreation participation data useful to the BLM for planning and managing recreation on Public Land?

A proposal was submitted in early summer 1976 resulting in funding by the BLM to conduct research addressing these questions and other research priorities expressed by the BLM. The primary focus of the research conducted in this study was to develop a methodology and implement a pilot research project to investigate the second question listed above.

Research Objectives

The primary focus of this research is to design and implement a pilot study to:

(1) Produce summary statistics describing recreation participation in the selected study areas.

(2) Develop a procedure for determining estimates of the necessary sample sizes for future Colorado SCORP demand surveys designed to provide recreation participation data useful to the BLM.

Review of Pertinent Literature

This section reviews the recreation literature pertinent to the problem of developing sample sizes for recreation surveys. Since documentation of this problem is limited, the discussion outlines the problems, importance, and advantages of determining accurate sample sizes before implementing a survey.

"Survey sampling, or population sampling, deals with methods for selecting and observing a part (sample) of the population in order to make inferences about the whole population" (Kish 1967). Compared to complete enumeration in censuses, survey sampling offers some distinct advantages. The most obvious advantage of gathering data on a sample basis is reduction in cost. Other advantages include increased accuracy and greater speed (Cochran 1963). Bauer (1966) indicates that sample surveys can be more accurate than census surveys because, "it is possible to invest more time, effort, and money in each unit in a sample survey."

Sampling, as opposed to complete census, has played a key role in the methodologies developed to estimate recreation participation. The population of recreation users at dispersed recreation areas is hard to identify. Lucas, Schreuder, and James (1971) outline the problem in wilderness areas. "Wilderness users are highly mobile and are scattered widely over large areas." The problem is also evident in other dispersed recreation areas and some developed sites where users can access areas at many points during the day and night. James and Harper (1965) illustrate the absurdity of surveying all the recreation users of a recreation area by calculating the total hours necessary to complete a total enumeration survey at a recreation area in Florida. They write:

> Total sampling opportunity, based on sampling all exits 24 hours each day during the sampling year was 2,969,640 hours. This type of total census is, of course, so difficult and expensive that it is impractical.

Although the advantages of sampling versus complete census are clear, sampling techniques are complicated and many problems still exist which must be addressed. Continued research is needed to improve the efficiency and precision of sampling procedures to provide recreation specialists the "tools for managing the recreation resource more effectively and inexpensively" (James, Wingle, and Griggs 1971). The prime need for recreation planners and managers is "figures of known accuracy" (Marcus, Gould, and Bury 1961).

Most of the statistical research in recreation addressing sampling problems focuses on developing techniques for estimating recreation participation and on discussing different ways of analyzing the data to provide the most accurate estimates. George James has been involved in numerous research projects developing techniques for estimating

recreation use in developed and dispersed recreation areas (James and Harper 1965; James and Henley 1968; James and Quinkert 1972). Other researchers have also focused on developing techniques for measuring recreation use (Cushwa and McGinnes 1963; Marcus, Gould, and Bury 1961). Lucas, Schreuder, and James (1971) pilot tested different sampling procedures for estimating wilderness recreation use in the Mission Mountains in Montana. They compared different sampling procedures and data analysis procedures to determine which provided the best estimates. There are many other studies that focus on developing and testing different techniques for measuring and estimating recreation participation, but it is beyond the scope of this paper to list them all.

Review of the literature cited above and other recreation studies developing statistical techniques reveals that most recreation literature does not address the problem of determining proper sample sizes for the techniques employed in those studies. The problem has been alluded to, but little research has been initiated to explore the problem. In the studies that identify the problem of sample size levels, the majority of the documentation outlines why a rigorous method was not used. James and Harper (1965) used sample size recommendations from Cushwa and McGinnes since "no presampling had been done to determine coefficients of variation and sample size." Yet, Cushwa and McGinnes (1963) were confronted with the same problem and forced to allocate sample sizes in individual strata arbitrarily. It was determined in their study that recreation use could have been estimated with the same percentage of error if the sample had been allocated more efficiently to individual strata. Regarding the use of their techniques in other areas, it was indicated that their "basic principles" are universal, but

"characteristics of exits and seasons will vary with local conditions and will affect sample size and allocations needed to obtain estimates at desired levels of accuracy." There was no mention of a technique for determining sample sizes for surveys in other areas. Lucas and Oltman (1971) describe the problem of determining sample sizes for recreation surveys.

> The number of visitors within each primary sampling unit is always unknown or known only very roughly before sampling. Thus, it is not possible to follow the usual sample design steps of (1) selecting the desired level of precision, (2) calculating the sample size needed to achieve it, and (3) obtaining a sample of that size.

This reiterates the problem of determining the population using a recreation area and estimating the variation in that population for specific variables.

A review of the procedures used by 25 states' SCORP demand analyses indicate that the sample size problem was not a major consideration. Documentation of the methodology used to determine sample sizes for the demand surveys was fragmentary and incomplete. Michigan published a detailed description of the procedures used in the 1976 Michigan recreation survey. Sample sizes were based on the estimated number of interviews that could be completed annually. The principle consideration in developing sample sizes was the budget (Michigan Department of Natural Resources 1977). The budget available for implementing a survey was the principal criterium used to determine sample sizes by all the reviewed state SCORP demand surveys.

Literature focusing on sample size problems outside the field of recreation addresses the advantages, importance, and desirability of determining sample sizes accurately. Connell (1963) recommends selection of the smallest sample size necessary to insure the required

precision. He goes on by stating that a sample size that is too large wastes money and time on observations that are not needed. If the sample size is too small, the investigator runs the risk of erroneous conclusions. Nam (1973) summarizes the desirability of determining the appropriate sample sizes. "Finding the optimum sample sizes in the design reduces both the number of inconclusive investigations and the amount of ineffective or wasteful experimentation." To determine the correct sample size it is important to identify the principal variables for which estimates are desired at specific precision levels. Sample size calculation should be based on known information about those variables. Other variables sampled will then have higher or lower levels of precision compared to the principal variables (Zarkovich 1965).

A study conducted by Crapo and Chubb (1969) investigated techniques for determining recreation day use at Michigan park and recreation areas. They documented a procedure for determining sample sizes to acquire information for "that critical question which has answers of least reliability." It was decided that the estimation error should not exceed .05 at the 95% confidence level. Since no information was available describing the variability of the population for the "critical question", maximum possible population variance was assumed and an absolute error value (.05) in units of the estimate was set. This information allowed them to calculate sample sizes. Although the sample sizes were determined for a specific error level, without information describing the expected range of the estimated population value for the desired characteristic the expected precision of the estimate could not be determined. The sample sizes were based on desired absolute error, not on error in terms of the estimate. The article

concludes by recommending that the standards in the recreation research field be raised to prevent management decisions based on "erroneous conclusions". They also suggest that an estimation error of .05 at the 95% confidence level be used to calculate sample sizes.

When sampling from a population where the variation in the desired characteristic is unknown, a pilot (exploratory) study can provide valuable information. In addition to an estimate of the population variation, a pilot study can be used to develop field procedures, validate questionnaires, and train interview personnel (Yates 1949). The principal problem with this procedure is the cost of implementing a pilot study. Most surveys are constrained by budgetary limitations which incline the investigators to allocate all the funds to the actual study. If the funding is available, a pilot study is a useful tool for estimating the variation in an unknown population.

CHAPTER II. METHODOLOGY

This chapter describes the design, structure, and implementation of the survey techniques used for collection of the dispersed recreation use data. The first section overviews the general structure of the survey techniques; the study areas are described in the second section. In the third and fourth sections the specific components of the survey technique, sampling design, questionnaire design, and equations and procedures used to analyze the sample data are explained in detail for each survey. The last section outlines how the sample size estimates produced from each survey technique are compared.

OVERVIEW

The design and pilot testing of a survey technique for this study provided recreation use data to estimate sample sizes for future SCORP demand surveys for Colorado counties containing Public Land. The scheme required a sampling procedure oriented toward collecting the recreation use sample data at the county level which disaggregated two components of recreation participation at the county level. The first component, in-county recreation participation, represented the recreation use of areas within the county by residents of the county. The second component focused on the recreation use of county areas by out-of-county recreationists. The out-of-county recreationists were divided into two groups: (1) the out-of-state recreationists, those people who traveled from other states to recreate in a specific county in Colorado, and (2)

in-state (intercounty) recreationists, those people who traveled from their residence (origin) county[2] to a specific (destination) county[3] to recreate. This study was done to measure the inter-county and in-county (i.e., in-state) components of recreation participation at the county level. Two sample survey techniques were used to acquire needed data from recreationists in selected counties in Colorado. Inter-county recreation participation was measured by a roadside traffic-stop survey technique. Vehicles with out-of-county license tags were stopped as they traveled from the surveyed county and questioned regarding their recreation activities while in the county. Travelers with license tags registered outside the state were stopped and interviewed along with inter-county travelers. The second survey used a household telephone survey to measure resident recreation participation for in-county residents of the surveyed counties. Hereafter the two surveys will be termed roadside and household surveys.

The data collected during the two recreation surveys were used to describe the dispersed recreation participation in each of the surveyed counties. Those data also were used to estimate total recreation use for those counties and to calculate sample size estimates for future Colorado SCORP demand surveys for selected counties containing BLM Public Land. The dispersed recreation statistics describing participation were produced by interpreting and summarizing frequency outputs computed from the survey data. These data also were used to calculate the mean and variance

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[2]An origin county is defined as the county of residence in Colorado from which a recreation participant embarks on his recreation trip.

[3]A destination county is the county where the recreation participation occurred.

estimates needed to compute the total use estimates for each of the study areas for each survey technique. The total use figures and the associated mean and variance estimates were an integral part of the analysis designed to define the range of sample size estimates.

Results of the analyses performed on the sample data from each survey were used to estimate sample sizes for the number of household interviews needed from a statewide household origin county survey designed to obtain sample recreation participation data for destination counties in Colorado containing BLM Public Land. The criteria for deriving these estimates were based on determining the level of variability of the sample estimates associated with the data produced from each survey technique and the differences between the study areas in the recreational opportunities provided and distribution of recreation use. The procedure incorporated the sample data analysis from each survey to develop estimates of total recreation use for each study area. The precision of the total use estimates associated with each survey was defined by developing confidence intervals using population variance estimates produced from the sample data. Alternative precision levels were calculated for each survey and study areas to indicate the sample sizes necessary to acquire recreation participation data that would be more (or less) precise than the sample data according to the needs of recreation managers. The actual sample sizes calculated for each survey and study area were a function of the desired precision of the total use estimates.

Each survey technique was designed to produce sample size estimates for a different component of recreation participation. Since the sample sizes calculated from the roadside survey data were developed for a recreation survey on-site in a destination study, specific data from

that survey were analyzed to develop sample size estimates for a survey procedure designed to measure recreation participation in destination counties by sampling origin counties. The total number of visitors from each origin county in Colorado going to the study areas (i.e., destination counties) were estimated from the roadside survey data. From the information and the sample size estimates calculated for different precision levels, a proportional equation was used to calculate the number of interviews necessary in each origin county to acquire recreation information from the residents of those origin counties who participated in recreation activities in one of the study areas. The household survey data from this study were used to calculate the sample size estimates necessary to compute resident recreation participation for county residents of the study area selected.

Calculations of final sample size estimates for each of the study areas were based on comparisons of sample sizes produced from each survey. The survey data set producing the widest range of variability around its total use estimate would need larger sample sizes than the survey with more precise estimates to acquire the same level of precision from the information in each survey. Therefore, if inter-county recreation participants engage in a broader range of recreation activites over a wider range of length-of-stay periods than the in-county participants, the roadside survey participants' data would have larger variance estimates and the sample needed to produce the total use estimates at a uniform precision level for that survey would be larger.

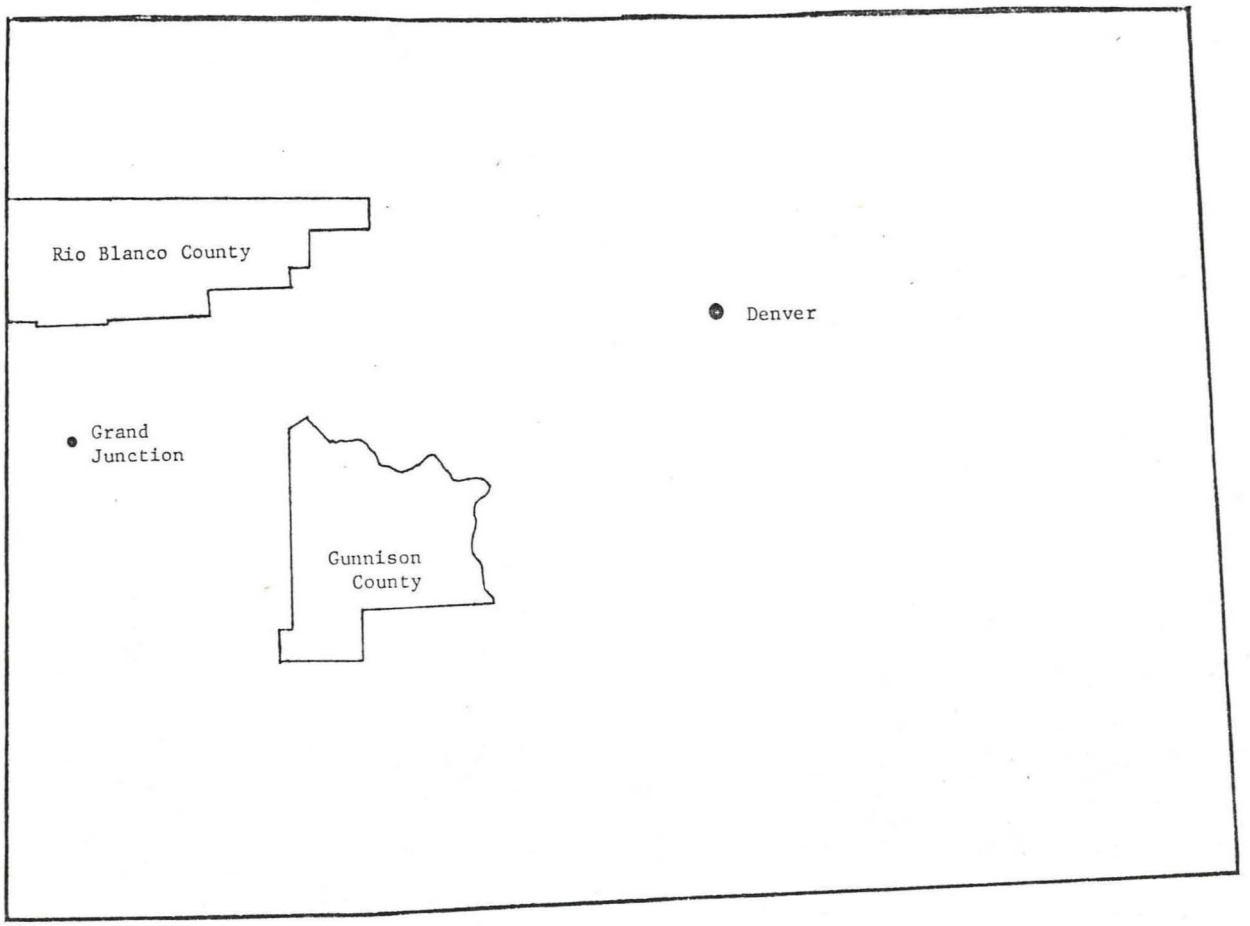
The procedure designed to select the study areas was used to determine the relative sample sizes necessary to obtain dispersed recreation use information from other counties in Colorado with large amounts of

Public Land. Two study areas were chosen from all counties containing significant amounts of BLM Public Land to represent the extremes (maximum and minimum) of variability associated with the dispersed recreation opportunities provided and the levels of dispersed recreation participation. Therefore, the sample size estimates calculated from the roadside and household survey analyses for each study area were expected to define these maximum and minimum levels of sample size estimates. By ascertaining the degree of similarity of dispersed recreation opportunities and dispersed recreation participation between the sampled counties and all other counties containing Public Land, estimates of sample sizes for futue SCORP surveys in each of the non-sampled counties can be determined by adjusting the estimated sample sizes between the maximum and minimum levels to correspond to the county being considered.

STUDY AREAS

There were two reasons for the selection of Colorado as the location for this research: (1) the Colorado BLM State Office identified the need for dispersed recreation research on Public Land in Colorado, and (2) the research organizations are based in Fort Collins. The map in figure 1 shows the location of the two study areas. Counties were used to define the boundaries of the study areas to conform to the design structure used by the State of Colorado for the SCORP demand surveys. Budget and the logistics of implementing the surveys limited the number of counties to two. Consultation with BLM Recreation Planners and Resource Managers established the following criteria for selecting study areas: (1) the

Figure 1. Location of study areas in Colorado



quantity and distribution of Public Land in the county; (2) the diversity of recreation opportunity on the Public Land; and (3) the estimated amounts of dispersed recreation taking place. With these criteria established, Gunnison and Rio Blanco Counties were chosen as the study Counties for the recreation participation surveys.

Gunnison County was selected to represent an area of high diversity of recreation opportunity and high recreation use on the Public Land. Most of the Public Land in the County are located in the southern part where the valley and stream bottoms are in private ownership and the hills are managed by the BLM. The Powderhorn Primitive Area along the southwestern boundary offers the most significant dispersed recreation from Public Land in the County. The vegetation on the Public Land varies from pinyon-juniper and light grasses at the lower elevations to high mountain ponderosa pine and spruce forests. The northern part of the County, primarily under Forest Service management, contains mountainous ecosystem characteristics of ponderosa pine and spruce forests alternating with mountain meadows of grasses and wildflowers. The popular recreation activities in the County are oriented around lake and stream fishing and exploration of historic mining towns. The National Park Service manages the Curecanti National Recreation Area in the west-central part where boating and fishing on Blue Mesa Reservoir are important recreation activities.

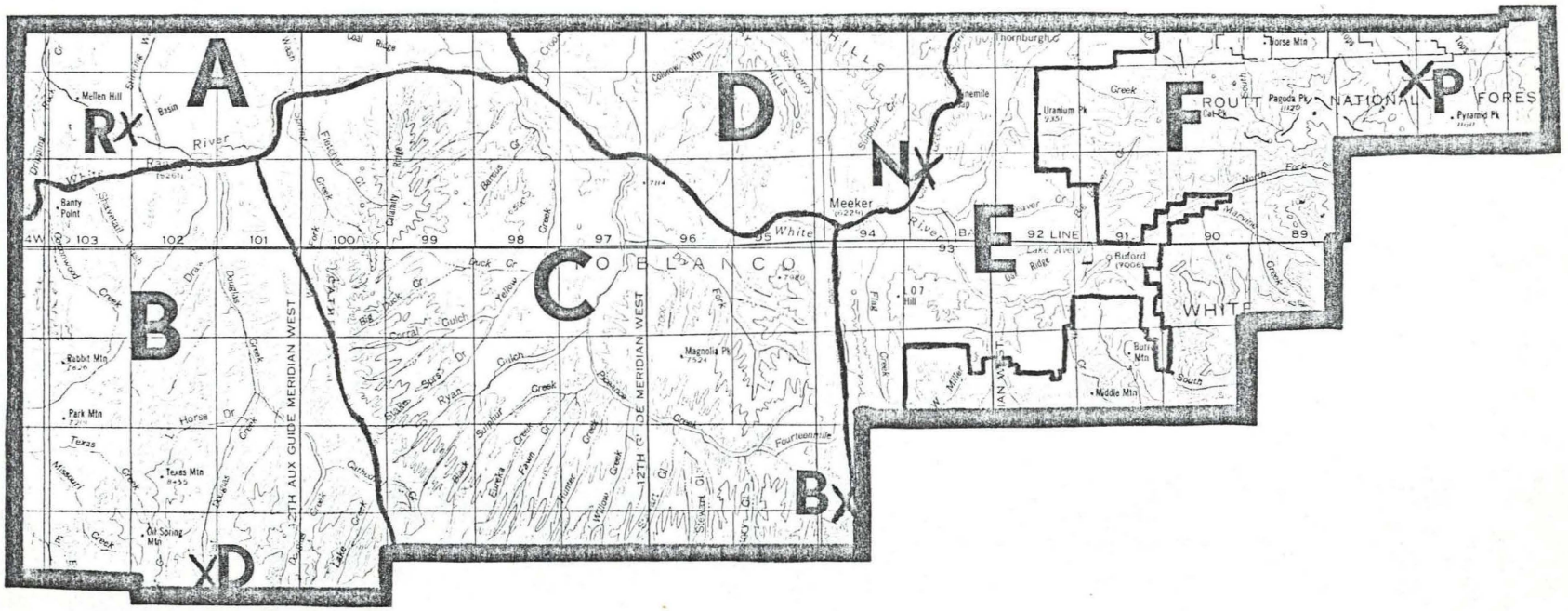
Rio Blanco County, with a high percentage of land administered by the BLM, is characterized by a low level of recreation opportunity and low dispersed use levels during the summer tourist season. Public Land dominates the western two-thirds of the County in large consolidated blocks. The terrain is characterized by a differentiated sedimentary

rock structure with predominant vegetative cover of pinyon-juniper, serviceberry, and short grasses. Deposits of oil, natural gas, and oil shale in the Piceance Basin mark the western and central areas for energy development. The eastern end of the County contains spruce forests, scattered meadows, and alpine lakes under Forest Service management. The predominant management unit in this section is the Flattops Wilderness Area on the eastern boundary. Hunting is the principal dispersed recreation activity in the County, and the peak time of year for hunting is associated with the fall deer season.

Figures 2 and 3 on pages 18 and 19 show zone divisions and roadside survey locations for the two study areas. Zone boundaries correspond to the Planning Units or Divisions used by the BLM for recreation planning. The use of zones during data collection and analysis produced more specific information concerning areas of recreation use. The survey locations were set up just inside the County borders on roads with the highest volumes of traffic as shown by historical use statistics from the Colorado State Department of Highways. There were five roadside survey locations in Rio Blanco County (figure 2) and seven stations in Gunnison County.

As outlined in the Overview, the two study areas selected were expected to produce recreation participation data that represented the maximum and minimum levels of recreation use variability compared to all counties containing significant amounts of Public Land in Colorado. The range of variability of the sample data between the study areas, as delineated by the precision of the estimates, aided in structuring the maximum and minimum limits of the sample size estimates for future SCORP demand surveys designed to produce useful dispersed recreation information.

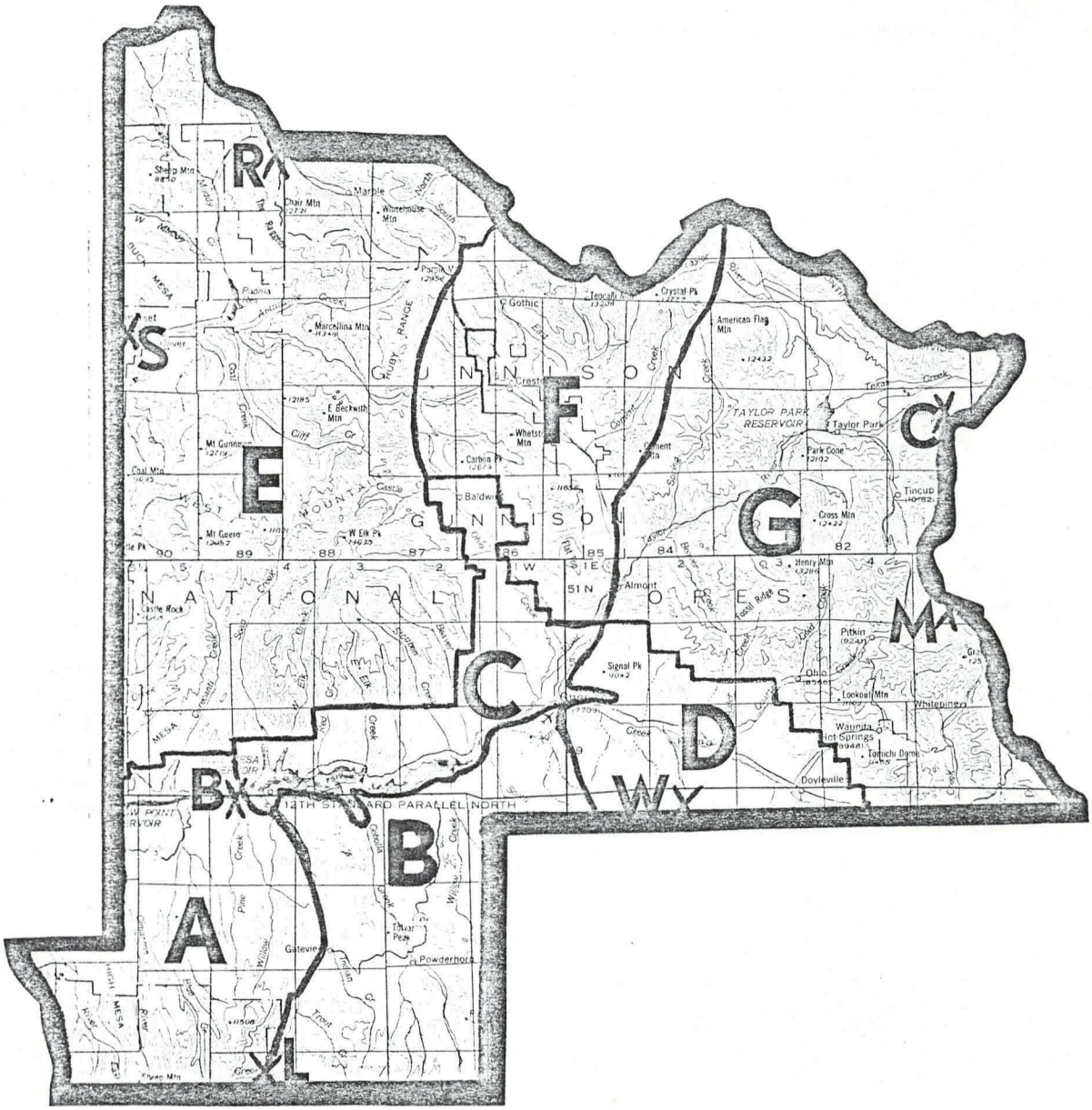
Figure 2. Zone divisions and interview stations for the Rio Blanco County study area (summer 1977)



X (and small letters) - Roadside survey locations

A, B, etc., (large letters) - Zones

Figure 3. Zone divisions and interview stations for the Gunnison County study area (summer 1977)



X (and small letters) - Roadside survey locations

A, B, etc., (large letters) - Zones

ROADSIDE SURVEY

The roadside survey was designed to sample the dispersed recreation use of Gunnison and Rio Blanco Counties by recreation participants living in areas outside the county being sampled. The technique designed was an adaptation of a roadside survey procedure used by Driver and Brown[4] in 1976 to conduct behavioral recreation research. Their technique acquired names and addresses from a sample of backcountry recreationists exiting proposed or established Wilderness and Primitive areas using a traffic-stop survey method. This roadside survey technique differed from the previous studies of Driver and Brown in two ways: (1) the primary purpose was to acquire dispersed recreation use data on a county-wide basis from all types of users, and (2) the roadside survey sampled only one component of the dispersed recreation participation of the surveyed areas (i.e., only recreation visitors from other counties and states were surveyed).

This section has been divided into two parts: (1) survey procedures; and (2) strategy for analysis. Included in the survey procedures section will be a description of the general survey technique, the survey and sample design, and the questionnaire design. The strategy for analysis presents the methodology used to transform the sample data collected during the roadside survey to estimates of sample sizes for a household origin county survey.

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[4]Driver, B.L. and Perry J. Brown. 1976. Identifying Resource Attributes Providing Opportunities For Dispersed Recreation. Unpubl. Study Plan for CSU-RMS Cooperative Agreement 16-631-CA.

Survey Procedures

General survey technique

Traffic-stop interview locations were on major state and county highways. Vehicles were stopped as they exited the study areas. Non-commercial vehicles with out-of-county license tags were flagged to the side of the road on a random basis by interview personnel. Vehicles were stopped for the interview when the previous interview was completed and the interviewer could safely extract a vehicle from the normal traffic flow. Once the vehicle was stopped, the interviewer proceeded to conduct the interview according to a predetermined set of decision rules (appendix A). The interviewer approached each vehicle and questioned either the driver or front seat passenger based on a systematic routine for identifying the interviewee. Interviews were shifted from driver to passenger to obtain a more representative list of area users. Since drivers exiting recreation areas tend to be males and heads of households and our interests were in other users' recreation activities as well, a practical compromise for obtaining a representative sample was to systematically shift from driver to passenger. All interviews were conducted while the respondent remained in the vehicle. If the interviewee declined to cooperate with the survey, he/she was thanked for the time spent and recorded as a non-respondent on the interview form. Any information or comments about an individual interview or the interview period were recorded in a notebook for future reference.

Survey and sampling design

The roadside survey was designed to sample dispersed recreation use during the summer recreation season of 1977. The sampling period in each

of the study areas lasted 77 days, from June 16 to August 31. The sampling scheme consisted of randomly selecting a sample of recreation users from the total population of recreationists in each study area during the sampling period. The sample design was a stratified random sample clustered by days. A stratification structure partitions a target population into a number of homogeneous groups. In this study each roadside traffic-stop station was a stratum. In addition, another stratification structure delineated the weekend, weekday, and holiday differences. The size of the sample selected from each stratum was a function of the total population (in this case, vehicles passing by the interview station) of that stratum. A scheme utilizing the concept of sampling proportional to use assigned the appropriate number of interview periods to each station according to the amount of vehicular traffic at that station. In addition to the stratification structure the sample was further divided into clusters comprised of days. Each cluster consisted of a day, with the elements of that cluster defined as the total number of vehicles exiting the study area on that day. A sample of clusters was taken from the whole sampling period (i.e. summer) by selecting specific sampling dates. Once the sample of clusters was selected, the actual interview time period within each cluster represented a subsample of the elements of that cluster.

The sampling scheme was limited to the extent that the sample sizes selected for each study area could not be estimated from population variance estimates for selected important variables. Sample sizes can be calculated for surveys in areas where previous studies have defined, measured, and produced population variance estimates of the same variables to be quantified in the new study. Since data for specific variables

needed to produce variance estimates were not available for the study areas, the sample size estimates determined for this study were primarily a function of vehicular volume estimates obtained from the Colorado State Department of Highways and of budgetary considerations. The highway data specified the daily volumes, peak periods, and hourly estimates of traffic flow on major highways leaving the study areas. Table 1 shows the twenty-four hour estimates of traffic flow and percentages of total county traffic volume at each station on major highways in each study area. The number of sampling days in each study area were primarily a function of budgetary constraints, since interview crews were commuting from Fort Collins, Colorado to each of the study areas throughout the summer sampling period. Each study area was allocated a total number of interview trips during the summer. The number of sampling days assigned to each station was structured to reflect sampling proportional to the volume of traffic at each station by multiplying the percentage of total county traffic at each station by the number of sampling days allocated to the county. Stations with high vehicular traffic volumes were sampled more times than stations with low traffic volumes.

The sampling schedule for each study area was designed to obtain a representative sample of recreation users throughout the summer sampling period. The roadside interviews at traffic-stop locations were conducted in two three-hour blocks during each selected sampling day. The starting time of each three-hour interview block was varied for each station throughout the sampling period to cover the full range of time that people were expected to leave the study area. The two three-hour interview blocks were separated into two time regimes used

Table 1. Twenty-four hour total traffic estimates by interview station (Roadside survey, summer 1977).

County	Station	Total Traffic	Percent[a]
Rio Blanco	Rio Blanco	1,200	35
	Pyramid	83	4
	Ninemile	860	25
	Rangley	790	23
	Douglas Pass	450	13
Gunnison	Somerset	900	14
	McClure	200	3
	Cottonwood	510	8
	Monarch	2,000	32
	West Pass	280	5
	Lake City	290	5
	Blue Mesa	2,050	33

[a]Calculated using the total county traffic figure in the denominator.

on separate days: (1) 9 to 12 p.m. and 2 to 5 p.m.; and (2) 11 to 2 p.m. and 4 to 7 p.m. Tables 2 and 3 list the survey dates, stations, and beginning interview times for the summer sampling in each study area.

Inductive loop and pneumatic traffic counters were used to determine total traffic estimates during the summer sampling period. Inductive loop counters were preferred over pneumatic counters, because the counting mechanism in an inductive loop counter is triggered by a vehicle breaking an invisible electronic field set up by a wire loop buried under ground. Pneumatic counters register a vehicle by sensing a change in air pressure as a vehicle's tires depress a rubber hose stretched across the highway. Vandalism, rubber hose deterioration due to heavy traffic, and inaccuracies in the recording mechanisms make pneumatic counters less desirable for traffic estimates where a counter is left unattended for extended periods of time. Unfortunately, only one inductive loop traffic counter could be installed since installation with available equipment required a dirt or gravel road base for placement of the wires six inches below the surface. There was only one location in either study area where a dirt or gravel road base existed. Pneumatic counters with hose attachments were used on asphalt highways for short time intervals when constant monitoring was available to insure the accuracy of the counts.

Questionnaire design

A one-page questionnaire (appendix A) was designed to record the information obtained during the roadside interview. The questionnaire was designed to be completed by the interviewer as the questions were answered by the respondent. Questions and information recorded on the questionnaire were reviewed with BLM personnel before the implementation

Table 2. Sampling Schedule for Rio Blanco County (Roadside survey, summer 1977)

Date	Station	Beginning Time
June		
16	Rio Blanco	2 p.m.
17	Rangely	9 a.m.
17	Douglas Pass	2 p.m.
18	Rangely	9 a.m.
18	Ninemile	2 p.m.
19	Ninemile	9 a.m.
19	Rio Blanco	2 p.m.
July		
1	Ninemile	2 p.m.
2	Douglas Pass	9 a.m.
2	Rangely	2 p.m.
3	Rangely	9 a.m.
3	Rio Blanco	2 p.m.
4	Rio Blanco	9 a.m.
4	Ninemile	2 p.m.
16	Pyramid	2 p.m.
17	Douglas Pass	2 p.m.
18	Douglas Pass	9 a.m.
18	Rangely	2 p.m.
19	Ninemile	9 a.m.
19	Rio Blanco	2 p.m.
20	Rio Blanco	9 a.m.
August		
23	Pyramid	2 p.m.
24	Ninemile	9 a.m.
24	Rio Blanco	2 p.m.
25	Rangely	9 a.m.
25	Douglas Pass	2 p.m.
26	Rangely	9 a.m.
26	Ninemile	2 p.m.
27	Rio Blanco	9 a.m.

Table 3. Sampling Schedule for Gunnison County (Roadside Survey, summer 1977)

Date	Station	Beginning Time
June		
24	Monarch	2 p.m.
25	50W	9 a.m.
25	Lake City	2 p.m.
26	50W	9 a.m.
26	West Pass	2 p.m.
27	Somerset	9 a.m.
27	McClure	2 p.m.
July		
8	Cottonwood	2 p.m.
9	West Pass	9 a.m.
9	Monarch	2 p.m.
10	Monarch	9 a.m.
10	50W	2 p.m.
11	50W	9 a.m.
11	Lake City	2 p.m.
12	Cebolla	9 a.m.
August		
10	McClure	2 p.m.
11	McClure	9 a.m.
11	Somerset	2 p.m.
12	Monarch	9 a.m.
12	50W	2 p.m.
13	50W	9 a.m.
13	Monarch	2 p.m.
14	Cottonwood	9 a.m.

of the survey. For recreationists participating in recreation activities in the study area, the interviewer recorded the following information: (1) location, date, and time of interview; (2) activities participated in; (3) total time spent in study area and each zone; (4) most important activity; (5) number of people in the household present, and at home; and (6) other pertinent observational data including vehicle type, license tags by county or state, and age and sex classes. Hours of recreation participation was the most important information on the form, since it is the key variable for the calculation of total dispersed recreation participation and provides the basic data for the sample size estimates. The length and structure of the questionnaire was designed to provide a short concise interview instrument to expedite the interviewing process.

Strategy for Analysis

This section outlines the procedures followed and equations developed for the analysis of the summer survey data from the roadside traffic-stop survey. There are three parts of the analysis methodology: (1) sample data analysis; (2) estimates of total recreation use; and (3) sample size determinations.

Sample data analysis

The initial analysis was designed to produce summary statistics on where, in what activities, and how long people were recreating in the study areas. The first step was to transfer the data to computer cards by coding the questionnaires, keypunching the coded information onto computer cards, and verifying the punched cards. The principle analysis

tool used was the Statistical Package for the Social Sciences (SPSS) (Nie et al. 1975) computer programs. Utilizing primarily the frequencies program, the raw data were summarized to produce tables describing the recreationists' responses to all the questions on the interview form.

Estimates of total recreation use

The roadside survey was designed to measure recreation participation of people visiting the study areas from other counties in Colorado and out-of-state locations. The information from these sample data was used to determine estimates of total recreation participation for the summer season for all people recreating in Gunnison or Rio Blanco Counties from outside the study areas. To transform the sample recreation data from individual sampled days to estimates of total recreation participation for the summer season, the population of recreationists using the study area during the sampling period was needed. But, this information was not known and not easily determined. Therefore, the population for the purposes of this study was defined as the number of vehicles exiting the study area during the summer season. This figure was estimated from road counter data and observed traffic totals during the interview periods.

For estimates of total recreation use the term recreation use must be defined as a variable describing recreation participation for which information was obtained during the interview period for each respondent. In this study the number of hours of recreation participation was used to define total recreation use. This variable was selected as the primary unit of analysis for the total use estimates because: (1) it was felt that people could report accurately their arrival and departure times with respect to recreation participation in the study areas;

(2) every person who indicated recreation participation reported a value for this variable; (3) total hours of recreation participation describe all recreation participation in a common unit (i.e., hours); and (4) total hours of recreation participation (visitor days) are important to the agencies for planning efforts and funding justifications. In this study the total hours of recreation participation were calculated for each vehicle[5] by multiplying the hours of recreation indicated by the respondent times the number of people in the vehicle from the same household as the respondent. To include the occupants from each vehicle stopped in the figures for total recreation use, it was assumed that the people in the vehicle were in the study area the same amount of time as the respondent and participating in recreation during that time. Only members from the same household in each vehicle were included in the recreation use figures to facilitate the development of the sample size estimates for a household survey.

The sampling design outlined on page 22 of this chapter describes the roadside survey as a stratified random sample clustered by days. This scheme, which was developed to select a sample of recreation participants in each study area also structured the total use estimation procedure. The weekend, weekday, holiday stratification structure was eliminated from the analysis of the data since the number of interview periods in each stratum was considered too small to support stratification. Even so, the sample was considered to represent the recreation

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[5]It is not implied by this statement that a vehicle has been recreating in the study area. But, the recreation participation of the occupants of the vehicle will be referred to as the total recreation participation per vehicle.

participation of recreationists on weekends, weekdays and holidays since the sample was designed to obtain information from each of these divisions.

Two estimation procedures, based on the sample design employed by the roadside survey, were reviewed to determine the best procedure for this study. They are the unbiased estimation and ratio estimation procedures. Initially, it was determined that the sampling units selected during the summer sampling period were the individual clusters or days. But, when the estimation procedures were reviewed and the sample design evaluated further, it became apparent that the primary unit sampled was not a day, but the total traffic exiting each study area at a station on an interview day (i.e. the elements of that cluster). This information indicated that the primary units were of unequal size. Cochran (1963) recommends dispensing with a stratification structure using an unbiased estimation procedure in favor of one that compensates for basic sampling units unequal in size. The ratio estimation procedure was selected, because the formula adjusts for sampling units unequal in size, but depends on sampling proportional to the estimated use (i.e., in this study the vehicles exiting each station). The ratio formulas used in this study are outlined in Cochran (1963) and will be introduced as the description of the estimation procedure progresses.

During each interview the respondent from each vehicle was asked to indicate his/her hours of recreation participation in the study area. The total hours of recreation participation for that vehicle were determined using the procedure on page 30. Utilizing equation 2.1, the total hours of recreation per vehicle for all the respondents were combined to develop a mean number of hours of recreation per vehicle

for each sampled day. The associated variance is illustrated in equation 2.2.

$$\bar{y}_{ij} = \left(\sum_{k=1}^{m_{ij}} y_{ijk} \right) / m_{ij} \qquad [2.1]$$

$$s_{ij}^2 = \left(\sum_{k=1}^{m_{ij}} (y_{ijk} - \bar{y}_{ij})^2 \right) / (m_{ij} - 1) \qquad [2.2]$$

where: y_{ijk} = total hours of recreation at the i^{th} station on the j^{th} day for the k^{th} observation (i.e., interview)

m_{ij} = number of respondents at the i^{th} station on the j^{th} day

$\bar{y}_{ij}$ = mean hours of recreation participation for the sample obtained at the i^{th} station on the j^{th} day

s_{ij}^2 = variance for the mean hours of recreation participation at the i^{th} station on the j^{th} day

Traffic counter data and vehicular volume estimates provided by the Colorado State Department of Highways were used to determine the total traffic exiting the study area during the sampled day at the specific station. This estimate was adjusted by the observed proportion of commercial to total traffic during the interview period to determine the total traffic which would have been eligible for the survey during the sampled day. It was assumed that the occupants of the commercial vehicles had not participated in any recreation activities. The total traffic estimate and the means calculated above for each sampled day were used to develop an estimate of the population value for the mean hours of total recreation for each station across all the sampled days.

The summation in the numerator of equation 2.3 multiplied the total traffic estimated for each sampled day by the mean number of total hours of recreation for each sampled day to determine a total recreation figure for that day. When these values were summed for all the sampled days at a specific station and divided by the estimated total traffic leaving the study area by that station, an estimate of the population mean at that station was produced.

$$\hat{\bar{Y}}_{ir} = \sum_{j=1}^{n_i} M_{ij}\,\bar{y}_{ij} \Big/ \sum_{j=1}^{n_i} M_{ij} \qquad [2.3]$$

where: $\bar{y}_{ij}$ = mean hours of recreation obtained for the sample obtained at the i^{th} station on the j^{th} day

M_{ij} = traffic estimates (adjusted to exclude commercial traffic) at the i^{th} station on the j^{th} day

n_i = number of sampled days at the i^{th} station

$\hat{\bar{Y}}_{ir}$ = estimated mean hours of recreation per vehicle at the i^{th} station across all sampled days using a ratio estimate

This procedure effectively weights the sample mean values by the total traffic it represents and subsequently adjusts the estimate of the population mean. Therefore, an individual sampled day exhibiting high vehicular volumes will have more influence on the population mean estimate than a sampled day with low traffic levels.

The ratio formula used to estimate the variance for the mean total hours of recreation participation per vehicle for each station utilized two components of variance. The first component was the between component which measured the variation among the sampled clusters. If there was a large difference between the sample mean values for all the sample days used to formulate the mean population estimate, the between component of variation would be large. The second component measured the variability among the individual observations at a given station on a specific day and is called the within component of variance. This component utilized variances calculated for the sample mean from each sampled day to estimate the variability in the responses obtained on that day. The two variance components summed together produce the estimated variance for the population mean calcuated for each station. Equation 2.4 combines the two components into the variance estimation formula.

$$\hat{V}(\hat{\bar{Y}}_{ir}) = \frac{1-f_i}{n_i \bar{M}_i^2}\left(\frac{\sum_{j=1}^{n_i} M_{ij}^2(\bar{y}_{ij}-\hat{\bar{\bar{Y}}}_{ir})^2}{n_i-1}\right) + \frac{f_i}{n_i^2 \bar{M}_i^2}\left(\sum_{j=1}^{n_i}\frac{M_{ij}^2(1-f_{ij})s_{ij}^2}{m_{ij}}\right) \quad [2.4]$$

where: $f_i = n_i / N$, $\bar{M}_i = M_{i0}/N$, $f_{ij} = m_{ij}/M_{ij}$

N = total number of days in the summer sampling period

n_i = number of sampled days at the i^{th} station

M_{i0} = total traffic estimate at the i^{th} station for the whole summer

M_{ij} = total traffic estimate at the i^{th} station on the j^{th} sampled day

m_{ij} = sample size at the i^{th} station on the j^{th} day

$\bar{y}_{ij}$ = mean total hours of recreation per vehicle at the i^{th} station on the j^{th} day

s_{ij}^2 = variance for the mean total hours of recreation per vehicle at the i^{th} station on the j^{th} day

$\hat{\bar{Y}}_{ir}$ = mean total hours of recreation per vehicle at the i^{th} station for all sampled days using a ratio estimator

$V(\hat{\bar{Y}}_{ir})$ = variance for the i^{th} station mean estimate

To further clarify the selection of the ratio estimator used in this procedure, Cochran (1963) indicates that using an unbiased estimating procedure to calculate the variances for a sample with unequal or unknown cluster sizes would produce an artificially inflated estimate of the between units component of the variance equation. An example set of calculations used to develop the population mean and variance estimates for one station is contained in appendix B.

The mean and variance population estimating procedures for each individual station have been described. To develop an estimate of total recreation use the data from all the strata must be combined to form an overall stratified estimate. During the calculation of the overall estimates the mean estimates produced for each station (equation 2.3) were weighted to reflect the proportion of the number of total vehicles exiting each station to the total exiting the study area. If each station were assigned an equal weight in the stratification structure, the recreation use estimates from stations with only a small percentage

of the total traffic would have the same importance as the estimates produced for stations exhibiting a high volume of total traffic. In this case, the individual observations from low traffic stations would play a proportionally larger role in the calculations of the use estimates than the observations from stations with high traffic volumes. Therefore, a weighting structure was used to assign weights to the estimates according to the number of vehicles exiting each station.

There were two different techniques considered to calculate the weights assigned to each station. The first weighting procedure utilized the estimated total traffic exiting each station during the sampling period (i.e., summer season). If one station had twice the number of vehicles exiting than another station, the estimates produced from the first station were weighted twice as much. These are the actual sample weights. The second weighting procedure, historical weighting, used historical vehicular volumes passing each station to determine the weight assigned to each station. Actual weighting used the sample data as the weighting mechanism and was considered biased by the sample. Actual weighting would assume that the sample selected was representative or correctly described the situation. Historical weighting used information collected outside the sampling procedure and assumed that the patterns established in the past were consistent for the sampling period. Historical weighting was selected for the following reasons: (1) historical data specifying traffic volumes passing each station were available from the Colorado State Department of Highways, and (2) the sampling procedure designed for this study used historical traffic estimates to determine the number of sampled days at each station. Each weight was calculated using equation 2.5 illustrated below.

$$W_i = T_{io} / T_o \qquad [2.5]$$

where: T_{io} = total traffic exiting the i^{th} station from historical data

T_o = total traffic exiting all the stations in the county from historical data

W_i = weight for the i^{th} station

The overall stratified population mean estimate was determined by applying the weights from equation 2.5 to the mean estimates produced in equation 2.3. These values were summed in equation 2.6 outlined below. The associated variance estimate is described by equation 2.7.

$$\hat{\bar{y}}_{st} = \sum_{i=1}^{L} W_i \hat{\bar{\bar{Y}}}_{ir} \qquad [2.6]$$

$$\hat{V}(\hat{\bar{y}}_{st}) = \sum_{i=1}^{L} (W_i^2 \hat{V}(\hat{\bar{\bar{Y}}}_{ir})) \qquad [2.7]$$

where: W_i = traffic weight at the i^{th} station

L = number of stations in the county

$\hat{\bar{\bar{Y}}}_{ir}$ = i^{th} station population mean estimate (hours)

$\hat{V}(\hat{\bar{\bar{Y}}}_{ir})$ = variance for the i^{th} station mean population estimate

$\hat{\bar{y}}_{st}$ = overall stratified population mean estimate (hours)

$\hat{V}(\hat{\bar{y}}_{st})$ = variance for the overall stratified population mean estimate

Equation 2.6 produced an estimate of the mean number of total hours of recreation participation for any non-commercial vehicle exiting each study area during the summer sampling period. A total estimate of the recreation participation in each study area was calculated by multiplying the mean estimate (equation 2.6) by the estimated total number of noncommercial vehicles exiting the study area during the sampling period. This calculation is illustrated in equation 2.8 and is followed by the variance estimate, equation 2.9.

$$\hat{Y}_{st} = M_o \hat{\bar{y}}_{st} \qquad [2.8]$$

$$\hat{V}(\hat{Y}_{st}) = M_o^2 \hat{V}(\hat{\bar{y}}_{st}) \qquad [2.9]$$

where: M_o = total traffic estimate for each study area during the summer sampling period

$(\hat{\bar{y}}_{st})$ = overall stratified population mean estimate

$\hat{V}(\hat{\bar{y}}_{st})$ = variance for the overall stratified population mean estimate

$\hat{Y}_{st}$ = estimated total hours of recreation use

$\hat{V}(\hat{Y}_{st})$ = variance estimate for the total hours of recreation use

Sample size determinations

Total use estimate procedures outlined in the previous section provide recreation use information to the BLM and also provide the mean and variance estimates necessary to calculate the sample sizes to meet Objective 2 of this research. In this section are the procedures used

to calculate the statewide sample size levels necessary to implement a SCORP-like household survey producing recreation use information useful to the BLM. These procedures describe the analysis of the roadside component of the sample size estimates. The household component is discussed in a later section of this chapter. The analysis designed to produce the sample size estimates from the roadside survey data involve four steps: (1) precision of the total use estimates; (2) sample sizes for different levels of precision; (3) statewide sample sizes; and (4) sample sizes by origin region.

As described in the Overview section of this chapter, the roadside survey was designed to sample the in-state (inter-county) and out-of-state components of recreation use. The total use estimating procedure described in the preceding section was used to calculate recreation use estimates for the in-state component in addition to the total sample. The four step procedure described in this section will utilize the statistics from the in-state data only[6] to produce the final sample sizes incorporating an origin destination framework within Colorado. The equations used in this section are from Cochran (1963).

Precision of the total use estimates

The precision of the total use estimates of the sample data was determined from the mean and variance formulas described in the last section. The statistics from these formulas were used to develop confidence intervals which indicated or described the range of variability

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[6]An estimation procedure to develop sample sizes for sampling out-of-state recreationists was not the purpose of this study, but should be developed to augment the procedures established here.

associated with the estimates of the variable being measured. By assuming the estimates produced from the sample data were normally distributed, equation 2.10 was used to develop confidence intervals and deduce statements about the precision of the estimates.

$$\hat{\bar{Y}}_{st} \pm Z_{\alpha}\sqrt{\hat{V}\left(\hat{\bar{Y}}_{st}\right)} \qquad [2.10]$$

where: $\hat{\bar{Y}}_{st}$ = the overall stratified population mean estimate

Z_{α} = standard normal deviate with $1-\alpha$ level of confidence

$\hat{V}(\hat{\bar{Y}}_{st})$ = variance estimate for the overall stratified population mean estimate

This equation sets up a confidence interval for the overall stratified population mean from which the precision could be estimated.[7] Cochran (1963) states that "precision refers to the size of the deviations from the mean obtained from repeated application of the sampling procedure." In this instance the precision of the estimate was the deviation from the mean expressed as the right hand component of the equation. It is presented as a percentage of the mean in the analysis chapter by dividing the right hand component by the mean estimate and multiplying by 100. To determine the level of confidence associated with the estimate, the standard normal distribution was used to calculate the probability that estimates produced from repeated samples would fall within the established confidence intervals. In this

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[7] Confidence intervals for the total estimate were calculated using the same format as equation 2.10 described above, but the total estimate statistics were interchanged with the mean statistics.

study the standard normal deviate (Z) was used at alpha levels of .1 and .2 to produce confidence intervals for the 90% and 80% confidence levels. Since the level of precision associated with the estimates produced at each of the alpha levels varies, the precision levels were calculated for each confidence level to indicate the expected range of variability of the estimate.

Sample sizes for different levels of precision

There were no historical data available to give an indication of the variability associated with the use statistics that would be produced from different size samples which might be selected for the study. Therefore, there was no way of predicting how precise the use estimates would be and whether the survey would produce useful information. Since the desired level of specificity of the recreation use information was a function of the needs of an agency which can vary by location and over time, the total use estimates produced by this survey were analyzed to produce confidence intervals for two confidence levels at each of three levels of precision. These different levels provided information concerning the sample sizes necessary to implement a survey to collect data at the level of specificity desired. The levels of precision selected, represented deviations around the estimate of 50%, 25%, and 10% for alpha levels of confidence of .1 and .2 (i.e., 90% and 80% confidence levels).

The procedures which produced the sample size estimates at the individual levels of precision incorporated the ratio estimate variance formula (equation 2.7) which was used to estimate the variance for the overall stratified population mean estimate. By inputing the desired

precision levels (i.e., adjusting the variance for the overall stratified population mean estimate to reflect the desired precision levels) and assuming the within and between components of variance would remain constant for different size samples for each station, the new sample size estimates were calculated by adjusting equation 2.7 to solve for the new n. This adjustment is reflected in equation 2.11.

$$n = \sum_{i=1}^{L} (W_i^2 V_{1i} / \delta_i \bar{M}_i^2) \Bigg/ \left(V + 1/N \sum_{i=1}^{L} (W_i^2 (V_{1i} - V_{2i}) / \bar{M}_i^2) \right) \quad [2.11]$$

where: $V = (d/Z)^2$

$$V_{1i} = \left(\sum_{j=1}^{n_i} M_{ij}^2 (\bar{y}_{ij} - \bar{\bar{Y}}_{ir})^2 \right) / n_i - 1$$

$$V_{2i} = 1/n_i \sum_{j=i}^{n_i} \frac{M_{ij}^2 (1 - \delta_{ij}) s_{ij}^2}{m_{ij}}$$

$$\delta_i = n_i / n, \quad \bar{M}_i = M_{io} / N, \quad \delta_{ij} = m_{ij}/M_{ij}$$

n = new sample size at the desired precision and alpha levels

N = total number of days in the summer sampling period

n_i = number of sampled days at the i^{th} station

M_{io} = total traffic estimate at the i^{th} station for the summer

M_{ij} = total traffic estimate at the i^{th} station on the j^{th} day

m_{ij} = sample size at the i^{th} station on the j^{th} day

y_{ijk} = total hours of recreation at the i^{th} station on the j^{th} day for the k^{th} observation

$\overline{y}_{ij}$ = mean hours of total recreation per vehicle at the i^{th} station of the j^{th} day

s_{ij}^2 = variance for the mean hours of total recreation per vehicle at the i^{th} station of the j^{th} day

w_i = weight at the i^{th} station

$\hat{\bar{Y}}_{ir}$ = mean total hours of recreation per vehicle at the i^{th} station for all sampled days using a ratio estimator

d = desired precision in terms of the estimate

Z = standard normal deviate corresponding to the allowable probability that the error will exceed the desired margin

V = adjusted variance to reflect the desired precision and α levels.

Once the sample sizes were determined for each precision level, confidence intervals using equation 2.10 were developed for each precision level at both the confidence levels. The new sample sizes from this estimation procedure were determined for a roadside survey technique using the same sampling plan as the one designed for this study. The next section describes the procedure used to adapt these sample sizes to sample sizes for a statewide household survey design.

Statewide sample sizes

The roadside survey sampled the recreation participation of people exiting one of the sampled destination counties. A destination study in each county containing BLM land in Colorado utilizing the sample sizes calculated in the previous section would be a costly and time consuming undertaking. A more reasonable alternative would be to use the information from the two destination surveys to develop sample sizes for an origin study. An origin study using a household telephone survey was the last technique used by the State of Colorado to obtain recreation demand data from destination counties. Therefore, the sample sizes produced for the roadside survey at the specified precision levels were adjusted to reflect the sample sizes necessary to implement an origin oriented household telephone survey to acquire recreation use statistics at the desired precision levels. The problem was to determine the number of telephone calls necessary to acquire the number of interviews needed from respondents visiting the study areas. Information necessary to calculate these figures include the total number of vehicles exiting the study area from origin counties in Colorado and the number of households in Colorado. This section describes the techniques used to acquire the two information needs and calculate the statewide sample sizes for a household survey.

The sample data of the roadside survey interviews included information about the origin county of the respondent and the number of occupants in the vehicle from the same household as the respondent. Using the road counter data and the origin county information collected during the interview period, the total number of in-state vehicles exiting the study areas was calculated for each station over the summer

sampling period. These station data were summed to produce an estimate of the population of in-state vehicles exiting the study areas. An example of the estimation procedure is included in appendix B as part of an example of the total use estimating procedure. Data on the number of occupants in each vehicle from the same household insured that the recreation use statistics for in-state recreationists would describe the recreation participation from an individual household. This information could be collected from the respondent at home rather than in the field. In effect a vehicle became a household with respect to recreation participation. The total number of households visiting the study areas corresponded to the estimated total number of vehicles.

To calculate sample sizes for a statewide household survey, an estimate of the number of households in Colorado was needed. Since the sample sizes were to be used for a telephone survey, the population of households in Colorado was defined as the number of household telephone numbers in the state. The Mountain Bell Telephone Company provided these statistics including the number of household telephone numbers controlled by Mountain Bell, excluding commercial numbers, and the number of household telephone numbers administered by independent companies.

To determine the number of calls necessary statewide to contact a household which visited one of the study areas, the total number of household telephone numbers in Colorado was divided by the total number of households visiting each study area. The reciprocal of this proportion can be defined as the propensity of a household to visit the particular study area. The total number of calls necessary to complete the sample was calculated by multiplying the number of calls necessary for one interview by the number of desired interviews. This procedure was

followed to calculate the sample sizes of needed telephone calls for each precision level at both confidence levels for each study area. Equation 2.12 illustrates the proportion used to calculate the statewide sample size estimates.

$$n_h = (H_t / H_v) \times n \qquad [2.12]$$

where: H_t = total number of household telephone numbers in Colorado

H_v = estimated number of households visiting appropriate study area

n = sample size necessary to acquire recreation use statistics at the desired precision level (sample size from roadside survey)

n_h = estimated sample size reflecting the number of telephone calls needed statewide to acquire the number of interviews necessary (n)

Sample sizes by origin region

The sample size estimates from the preceding section defined the number of telephone calls needed statewide to acquire the needed number of sample interviews. This implies that a researcher could select a sample of households from the State of Colorado at the specified levels and obtain the sample desired. A more detailed analysis of the sample data indicated that the propensity of a person to visit one of the surveyed areas was influenced by other factors besides the population of the area where the respondent resided. This would indicate that a

random statewide sample with each household having an equal probability of selection might not produce the desired number of sample interviews necessary to acquire use statistics at the specified precision levels. Therefore, the information acquired during the survey sampling procedure was analyzed to reflect the propensity of a household to recreate in one of the study areas from an origin county. This analysis was incorporated into the sample size estimates by origin region.

The origin county information extracted from the survey questionnaire was used to determine an estimate of the total number of vehicles traveling from each origin county to the study areas during the summer season. But, it was determined that the roadside sample size was too small to reflect the differences in household behavior at the county level. Therefore, counties were aggregated into regions to provide enough sample observations to conduct the sample size determinations. To maintain consistency with the SCORP survey procedures, the first level of county aggregations utilized the SCORP planning units to group the counties into regions. When the available sample data for the newly aggregated regions were still too small for analysis, further aggregations were structured using these criteria to justify the groupings:

(1) Areas exhibiting similar propensities of a household to visit the same study area.

(2) Areas with similar situational characteristics (geographical locations) with respect to each study area.

(3) The size of the sample needed from each origin area.

The procedure for determining the sample size of household telephone calls necessary from each origin region used equation 2.13. This equation is the same general formula used to calculate the statewide sample sizes

in the preceding section (equation 2.12) except equation 2.13 incorporates the disaggregation to the i^{th} origin region.

$$n_{hi} = (H_{ti} / H_{vi}) \times n_i \qquad [2.13]$$

where: H_{ti} = total number of household telephone numbers in the origin region

H_{vi} = total number of households in the i^{th} origin region visiting the appropriate study area

n_i = number of needed interviews from respondents visiting the appropriate study area (roadside survey sample sizes)

n_{hi} = estimate sample size reflecting the number of telephone calls needed from each origin region to acquire the number of interviews necessary (n_i)

Household Survey

The household telephone survey was designed to measure the recreation participation of the residents of the sampled counties. The design and concept of using a household telephone survey used the 1973 Colorado SCORP Demand Survey (Colorado Division of Parks and Outdoor Recreation 1976) as a reference. This section of the methodology describes the survey procedures used during the implementation of the household survey and addresses the analysis of data.

Survey Procedures

Although the general technique used to acquire the sample data during the household survey was structured from the 1973 SCORP Demand

Survey, the questionnaire design, the technique of drawing the sample, the length of the sampling period, and the handling of the sample data varied from the procedures used by the State. This section describes the survey procedures of this study, including: (1) general survey technique; (2) survey and sample design; and (3) questionnaire design.

General survey technique

The household telephone survey consisted of two separate surveys completed during two one-week time spans in early August and September. Interviewers were instructed to dial selected telephone numbers between six and nine-thirty in the evening on specified interview nights to interview household members concerning their recreation participation. The respondents, always parents or household members over sixteen, were asked to recall the recreation activities of their household during a two-week recreation period prior to the interview. The interviewers were given explicit decision rules (appendix C) to follow while conducting the interview and filling out the questionnaire (appendix C) to maintain a homogeneous interview technique among interviewers. Once contact on the phone had been established, the average interview time was approximately five minutes. To insure that the recreation data collected were consistent for all respondents, the two-week recreation period remained constant for all interviews conducted during that survey period. The two-week recreation period sampled during the first one-week survey or interview period was July 18 to July 31, while the second period sampled was from August 23 to September 5. The selection of the specific two-week recreation periods to be sampled during the summer sampling period was based on the availability of manpower to do the

survey, the distribution of holidays throughout the summer, and the expected dispersed recreation use by county residents.

Survey and sample design

The survey and sample design of this study developed a technique of selecting the sample respondents where each individual in the population had an equal chance of being included in the sample. This was accomplished by reviewing the design and structure used by the State of Colorado in doing its 1973 SCORP Demand Study, and integrating these findings with other information obtained from literature describing sample selection procedures for household telephone surveys in various disciplines.

Sample design

An analysis of the documentation for the sampling design used by the 1973 Colorado SCORP Demand Survey for selecting its sample indicated that the systematic sampling procedure used could eliminate certain groups of individuals from the sample and increase the chances of selection for other individuals. The SCORP Survey selected sampling units by choosing every n^{th} telephone number from all telephone books in the state. When business numbers or disconnected numbers were encountered, the sample was replaced by the next consecutive number, which gives the replacement number a higher probability of being selected for the sample due to its proximity in the telephone book to business or disconnected numbers. The use of systematic sampling from telephone books as a selection procedure can introduce biases into the sample by eliminating groups of possible respondents from the sample who have unlisted telephone numbers, do not

have telephones, have had a phone just recently connected, or have a telephone with a new central exchange prefix. To reduce these kinds of biases the sampling design adopted for selecting the sample for this study was based on random digit dialing techniques discussed in articles by Glasser and Metzger (1972) and Sudman (1973).

The random digit dialing technique consisted of an initial determination of the central office prefixes[8] servicing the study areas. This information was acquired from the telephone companies controlling the telephone service to the two counties. These companies also supplied more detailed information necessary for implementing the procedure, including: (1) the number of working banks of 1,000 possible numbers within each prefix servicing the area; (2) for all prefixes, the number of household, as opposed to business, telephone numbers in each working number bank; (3) a count of the total working household numbers in each county. In some instances the number of working household telephone numbers in each individual number bank was not available from the phone companies, although the total for the prefix was known. For each prefix where this occurred, the total number of household numbers in that prefix and number bank were counted from a telephone book. A ratio was formed between the number of household numbers in the telephone book and the actual number supplied for that prefix by the telephone company to calculate the estimated number of working household numbers in each number bank. Equation 2.14 describes the operation of the ratio used:

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[8]The first three digits of the phone number constitute the central office prefix. The fourth number identifies a bank of 1,000 numbers which the phone company specifies as working or non-working depending on whether that bank contains numbers in or out of service. Each prefix contains a maximum of ten number banks of 1,000 telephone numbers each.

$$m_{ij} = (A_j / P_j) \times b_{ij} \qquad [2.14]$$

where: m_{ij} = estimated number of working household telephone numbers in the i^{th} bank in the j^{th} prefix

b_{ij} = number of household telephone numbers in the i^{th} bank in the j^{th} prefix counted in the telephone book

A_j = actual number of working household telephone numbers in the j^{th} prefix supplied by the telephone companies

P_j = number of household telephone numbers in the prefix counted from the telephone book.

This equation assumed that the distribution of total telephone numbers in each number bank in the telephone book would be representative of the actual distribution at the time of the survey.

The data supplied by the telephone companies and calculated by the ratio described above was used to determine the number of interviews necessary from each number bank. Given that the county-wide sample size had been determined (refer to paragraph 2 on page 57), the number of sample interviews in each number bank was allocated according to equation 2.15.

$$n_i = n \times (m_i / N) \qquad [2.15]$$

where: n_i = the number of sample interviews needed from the i^{th} bank

n = total sample size calculated for the county

N = total number of household telephones in county

m_i = the number of working household telephones in the i^{th} bank

This allocation procedure effectively self-weighted the sample size calculated for each working number bank to reflect sampling proportional to the number of household telephones in each bank. Therefore, number banks with a larger number of working household telephone numbers were sampled more than those banks with fewer numbers.

After determining the number of interviews required from each number bank, the actual telephone numbers were generated. A random number table was used to create the last three digits of each telephone number which were added to the prefixes and number banks supplied by the telephone companies. One problem was that numbers generated did not always correspond to a working household telephone number. Glasser and Metzger (1972) outlined some of the possible outcomes when a randomly generated number is dialed:

> "(1) a nonworking number (a recorded or live message stating that the call cannot be completed as dialed, no connection, a series of unanswered rings, or a wrong connection),
>
> (2) A working, but nonhousehold number (e.g., business telephone, public coin telephone), or
>
> (3) A working household number (a completed call, a series of unanswered rings, a busy signal, or a wrong connection)."

Therefore, it was necessary to generate a larger sample of random phone numbers in each number bank to complete the target number of household telephone interviews required to compensate for the number of non-connections, etc. In Rio Blanco County the telephone company was

able to supply information about the number of working household telephone numbers contained in the sixth digit of the telephone number. By furnishing an additional digit to each prefix and number bank, the telephone company reduced the number of random digits that needed to be generated for each number bank. This increased the efficiency of the household survey by reducing the total number of calls needed in each number bank to reach a working household number.

An information sheet (appendix C) was designed to record the outcome of each telephone number dialed. The interviewers were instructed to check (✓) the appropriate outcome of each telephone number dialed depending on whether it was the first, second, or third call. If a dialed number resulted in a series of unanswered rings or busy signals, at least two callbacks were made before discarding the number from the sample. Callbacks give possible respondents, who were not at home or were on the telephone during the initial call, a chance to be represented in the sample. To reach respondents with irregular work schedules, the second call was attempted during the daylight hours, and the third call tried during the early evening. If an interview was not achieved by the completion of the third call, the number was marked "never reached" on the information sheet and replaced in the sample by another randomly generated number.

Sample sizes

The sample size calculation for each county for the household telephone survey incorporated analyses of survey information from two different sources. The initial method utilized historical survey data from the 1973 Colorado SCORP Demand Survey. A preliminary analysis of

this survey information indicated that it was inappropriate for the determination of sample sizes for this study. Therefore, data from the roadside survey were used to help determine a general indication of the recreation participation in each study area and calculate the desired sample sizes. This section describes the initial calculation of sample sizes using 1973 SCORP Demand Survey data, the problems and limitations of using these data, and the final analysis of the sample size computations.

A statistical analysis of the available historical data was used to determine sample sizes for the summer household telephone surveys. The procedure was based on isolating the sample values for the specific variables producing the estimates of the true population values. Once this was specified, means and variances using the sample values of the variable were calculated to establish confidence intervals. Confidence intervals were used to indicate or describe the range of variability associated with the sample data or estimates corresponding to the variable being measured. If the amount of variability in the sample data from the historical survey were satisfactory, the sample sizes used in the historical survey could be adopted for the new survey. But, if the level of confidence associated with the estimate or the range of variability of the data expected were either too small or too large, equation 16 (Cochran 1963) had to be used to adjust the sample sizes for different levels of precision. One of the most important factors influencing the size of the sample selected was the cost of implementing the survey at the desired level of precision. Therefore, a compromise between the desired optimum precision of the estimate produced and the budget available to implement the survey resulted in sample sizes different than the optimum precision level.

The 1973 Colorado SCORP Demand Survey data were screened to aid the determination of sample sizes for the summer household telephone surveys. After the initial analyses of the survey design and calculations of basic statistics were completed, it became apparent that the reliability of the sample data would not allow the statistical analysis planned. Further information relating to the structure of the sampling design and methodology used to produce sample estimates of the population values needed for total recreation participation estimates was needed. The documentation of the survey procedures recorded in the 1974 Interim Plan and the 1976 Comprehensive Outdoor Recreation Plan was not in sufficient detail to support a statistical analysis of the data. Some of the problems are:

1. More information was needed to ascertain if each individual household in the state had an equal probability of being selected by the sampling procedure.
2. Detailed information regarding the structure of the sampling design was needed (e.g., was there a one-year sample of 6,025 in-state residents or 52 samples of 119).
3. The documentation concerning the structure of the interview and interview technique was general, and it was difficult to determine specifics.
4. The procedures used to calculate the use estimates (i.e., total recreation participation) from the sample data were not explained in the two documents outlining the procedure and methodology.
5. Calculations determining the precision of the use estimates with means, variances, and confidence intervals have not been

found in the literature describing the survey.

6. The format used by the State to store the data is compact and economically efficient, but data retrieval for analysis purposes was difficult and confusing due to ommissions and erroneous entries.

The answers to many of these problems could be determined if more precise information about the sampling design, etc. were available, but the time requirements imposed by the need to start the household telephone survey did not allow extensive search for such information. Therefore, data collected from the first series of interviews from the roadside survey were used to help determine the sample sizes for the household survey.

The roadside survey data were used, because other reliable information concerning recreation participation in the study areas was not available. The sample data were analyzed to ascertain sample estimates of the means and variances around total hours of recreation participation for all interviewed parties to indicate the degree of variability associated with the recreation participation in each county. Sample sizes were estimated using equation 2.16 (Cochran 1963) by substituting different confidence levels for each desired precision level using the variances calculated from the roadside survey data.

$$n = (Z\ \alpha\ S/d)^2 \qquad [2.16]$$

$$n = n_o\ /\ (1 + n_o\ /\ N) \qquad [2.17]$$

where: n_o = unadjusted sample size

$Z\ \alpha$ = standard normal deviate with $1 - \alpha$ level of confidence

S = standard deviation from the sample data

d = precision desired in units of the mean

N = total population size from which sample was selected

n = adjusted sample size

Where necessary equation 2.17 was used as a finite population correction[9] to revise the unadjusted sample size estimate when the sample size was larger than 10% of the population size (Cochran 1963).

In the sample calculations using equation 2.16 the variance estimates from the roadside sample data were held constant while the level of confidence and precision levels varied to produce the different sample sizes. This method of using the equation assumed that the variance estimates would remain constant for both survey techniques. This assumption is difficult to defend since the design, structure, and implementation of the two surveys were completely different. But the roadside survey data provided the only information for a general indication of the type of recreation participation and the associated means and variances needed to ascertain a range of sample sizes corresponding to different confidence levels. Therefore, the roadside survey information was used to reflect, not predict, the variation within the in-county recreation participation data in each county.

The final sample sizes were determined by balancing the budget available for the sampling with the sample sizes calculated above. The cost of implementing the survey at each of the alternative sample sizes was compared to the value of making decisions with different levels of

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[9]According to Cochran (1963), a finite population correction factor should be used in circumstances where there is a finite population and the sample size exceeds 10% of the population size. If this correction factor is not used, the standard error of the mean estimate will be overestimated.

confidence. The original design of the household survey incorporated one interview period for sampling during mid-summer 1977. Further review of this design indicated that an additional survey period should be added at the end of the summer to reflect the recreation participation and variability over a larger time frame. Budgetary constraints effectively limited the total sample size for both survey periods to the same size that would have been realized if only one survey period had been implemented. The overall reduction in the estimated level of confidence associated with the precision of the estimates for each survey period only was reduced from 90% to 80% for Gunnison County and 95% to 85% for Rio Blanco County. The additional information obtained from the two sampling periods was considered more valuable than maintaining the estimated confidence level of the estimates produced over 90%, since one of the primary goals of the households survey was to produce estimates of total recreation use for the summer sampling period.

Questionnaire design

The household telephone survey questionnaire (appendix C) was structured to reflect the same design used by the roadside survey questionnaire. To maintain a relatively uniform and consistent data base the item content of the activity lists and the socio-economic questions remained the same between the two questionnaires. Since space and handling problems did not exist during the telephone survey, the questionnaire was designed on three pages. The first page was structured to record the general survey information, designated activities, and socio-economic data. The second page was developed to describe the recreation trips so that hours of recreation participation could be

separated by zone, trip, participants, and total recreation for each household. An information sheet on page 3 was used as an accounting form to trace the result of each number attempted. Information obtained from the first call was used by subsequent interviewers attempting the second and third calls when necessary.

Strategy for Analysis

This section outlines the procedures and equations followed during the analysis of the summer survey data from the household survey. There are three components: (1) sample data analysis; (2) estimates of total recreation use; and (3) sample size determinations. The equations were formulated from a clustering structure introduced in Cochran (1963).

Sample data analysis

The initial analysis of the data collected from the two household telephone surveys paralleled the analysis of the roadside data. The recreation use data were coded into variables and transferred to computer cards by keypunching. Utilizing SPSS, the data were summarized to determine where, in what activities, and how long the survey respondents participated in recreation. The frequencies program in SPSS was used to calculate the summary statistics.

Estimates of total recreation use

The household telephone survey was structured to measure the recreation participation of the residents of the study areas. The survey consisted of two interview periods, each designed to sample recreation participation during a two-week recreation period.

Although the general survey technique and sampling design differed for the roadside and household surveys, the length of the sampling period and principal variable analyzed were consistent for the two studies and insured that recreation participation was being measured in similar units. Total recreation use for the household survey respondents was defined as the total hours of recreation participation by each household. This definition was adopted for the same reasons as those specified for the roadside on page (29). During the household interview the respondent was asked to recall the recreation participation by household members for recreation trips taken during the two-week recreation period. For each recreation trip, information was obtained concerning the total hours of recreation and the total number of household members participating. These two values were multiplied to produce the total hours of recreation on that trip. By summing the totals from each trip, a total household figure was calculated. Therefore, recreation participation with respect to the total use estimating procedure for the household survey was defined as the total hours of recreation participation per household, as calculated above, for a two-week recreation period.

The formulas and equations which produced the total use estimates for the household survey were less complicated than those adopted for the roadside survey. This was due primarily to the simple sampling design of the household survey. A cluster sampling structure was used to divide the 77 day summer sampling period into 5.5 two-week clusters. Two clusters were selected randomly for sampling. The elements of each cluster were defined as the total number of households in each surveyed County (i.e., Gunnison and Rio Blanco) having a working telephone. The

elements of the two clusters selected for sampling in each study area were subsampled randomly at the sample size levels calculated on page 57 of this chapter. The total population for the study in each study area was determined by multiplying the number of clusters in the sampling period by the number of elements in each cluster. The Mountain Bell Telephone Company provided the total number of household telephone numbers in each study area used to select the sample frame and calculate the total use estimates.

Using the recreation participation information (i.e., total hours of recreation participation per household) from each interview, the mean number of total hours of recreation per household was calculated for all the households from each survey period. Equation 2.18 was used to calculate these statistics. The associated variance of the sample mean was determined using equation 2.19.

$$\bar{y}_j = (1/m_j) \sum_{k=1}^{m_j} y_{ik} \qquad [2.18]$$

$$s_j^2 = \left(\sum_{k=1}^{m_j} y_{jk}^2 - m_j \bar{y}_j^2 \right) / (m_j - 1) \qquad [2.19]$$

where: m_j = sample size from the j^{th} survey period

y_{ik} = total hours of recreation from the j^{th} survey period obtained from the k^{th} observation (i.e., interview)

$\bar{y}_j$ = sample mean total hours of recreation per household for the j^{th} survey period

s_j^2 = variance for the sample mean for the j^{th} survey period

To maintain consistency between the roadside and household analyses of the data, the ratio estimation procedure adopted for the roadside survey was applied to the household data to calculate a combined mean estimate for the data collected from the two clusters sampled during the sampling period. This combined estimate of the population mean was determined using equation 2.20. Equation 2.21 is used to estimate the variance for the estimated population mean. This variance formula incorporates both the between and within components of variation used in the variance computations for the roadside survey data. For the household survey the between component describes the variation between the two clusters, and the within component measures the variation associated with the responses from within each cluster. These two components are combined in equation 2.21.

$$\hat{\bar{Y}} = \sum_{j=1}^{n} (M_j \bar{y}_j) \Big/ \sum_{j=1}^{n} M_j \qquad [2.20]$$

$$v(\hat{\bar{Y}}) = \frac{1-f}{n\bar{M}^2} \left(\frac{\sum_{j=1}^{n} M_j^2 (\bar{y}_j - \hat{\bar{Y}})^2}{n-1} \right) + \frac{f}{n^2\bar{M}^2} \left(\sum_{j=1}^{n} \frac{M_j^2 (1-f_j) s_j^2}{m_j} \right) \qquad [2.21]$$

where: $f = n/N$, $f_j = m_j / M_j$

N = total number of clusters in the summer sampling period

n = number of clusters sampled

$\bar{M}$ = mean number of total households across all sampled clusters

M_j = total number of households in the j^{th} cluster

m_j = total number of households sampled in the j^{th} cluster

$\bar{y}_j$ = mean total hours of recreation per household in the j^{th} cluster

s_j^2 = variance for the mean total hours of recreation per household for the j^{th} cluster

$\hat{\bar{Y}}$ = combined population mean estimate of the total hours of recreation per household

$\hat{V}(\hat{\bar{Y}})$ = variance for the population mean estimate

Assuming that the two survey periods were representative of all the two-week periods in the summer sampling period and that the populations remained constant during this same period, the mean estimates calculated from the sample data were inflated to determine a total estimate by adjusting the population mean estimate for the total hours of recreation participation per household. The adjustment used the total number of households in each study area and the number of two-week periods in the sampling period. Equation 2.22 is used for these calculations with the accompanying variance formula shown by equation 2.23.

$$\hat{Y} = N\ (M)\ \hat{\bar{Y}} \qquad [2.22]$$

$$\hat{V}(\hat{\bar{Y}}) = N^2\ (M^2)\ V(\hat{\bar{Y}}) \qquad [2.23]$$

where: N = number of clusters in the summer sampling period

M = population of households in each cluster

$\hat{\bar{Y}}$ = population mean estimate

$\hat{V}(\hat{\bar{Y}})$ = variance for the population mean estimate

$\hat{Y}$ = total estimated hours of recreation participation for the summer sampling period

$\hat{V}(\hat{Y})$ = variance for the total estimate

Sample size determinations

The procedures and techniques in this section were used to calculate the sample sizes designed to measure recreation participation during the sampling period for households that are located in the studied counties. The two steps in this analysis were the determination of the precision levels associated with the population mean estimates produced from the sample data and the determination of the sample sizes needed to sample recreation participation for the whole sampling period at different levels of precision and confidence. Many of the statistical procedures and explanations described in this section were utilized by the roadside survey analysis to calculate the sample size estimates. Where appropriate, the reader will be referred back to a specific section for a detailed explanation of the terms and equations.

Precision of the total use estimates

The procedure to determine the precision of the household survey population mean estimates calculated in this section utilized the equation used by the roadside survey (i.e., equation 2.10). By substituting the appropriate statistics from the household survey analysis into this equation, confidence intervals were calculated using the standard normal deviate at the .1 and .2 alpha levels corresponding to 90% and 80% confidence levels. The right hand component of the equation was used to calculate the precision of the estimate as a percent deviation from the mean.[10] The procedures to determine these calculations were described

[10]Confidence intervals and precision levels for the total recreation use estimates were calculated using the procedure and equation referenced above. But, the total estimate statistics were interchanged for the mean statistics.

on pages (40) and (41) of this chapter in the interpretation and explanation of equation 2.10. That explanation includes a description of standard normal deviate, confidence and precision levels, and confidence intervals.

Sample sizes for different precision levels

After precision calculations were made, sample sizes corresponding to selected levels of precision were determined. The purpose of calculating these sample sizes was to compare them to the estimates produced from the roadside data at the same precision and confidence levels. To facilitate a meaningful comparison, the principal variable had to represent the same recreation time period. The sample sizes produced from the roadside survey analysis were based on the recreation participation of households (vehicles) during a single trip to a specific study area. The analysis of the household survey data utilized the total hours of recreation of each household during a two-week recreation period. Therefore, the household survey data from each interview needed to be adjusted to reflect the recreation participation during just one trip across the two-week period. Since the household survey data were collected on a per trip basis, the average number of total hours spent on each trip was calculated for each household. Incorporating these data into equations 2.18 to 2.21 from the household survey analysis methodology on pages (62) thru (64), an adjusted population mean estimate for the household survey data was calculated based on the total hours of recreation during a single trip. Using the procedure described in the preceding section, the precision of the estimates and confidence intervals were determined using the standard normal deviate at the .1 and .2 alpha levels.

The precision and confidence levels selected for the household sample size analysis were the same levels used by the roadside survey analysis. The precision levels were 50%, 25%, and 10% deviation levels around the estimate, with alpha levels of .1 and .2 associated with 90% and 80% confidence levels.

The procedures which produced the sample size estimates at the individual levels of precision incorporated the ratio estimate variance formula (equation 2.21), which was used to estimate the variance for the adjusted population mean estimate. By inputing the desired precision levels (i.e., adjusting the variance for the adjusted population mean estimate to reflect the variance at each desired precision level) and assuming the within and between components of variation would remain constant for different sample sizes, the new sample size estimates were calculated by adjusting equation 2.21 to solve for the new sample sizes. This adjustment is reflected in equation 2.24.[11]

V_1 and V_2 correspond to the between and within components of variation.

$$m = 1 \Big/ \left(V - \left(\frac{(1-\delta)}{nM^2} V_1\right)\right) \frac{N}{V_2} + 1/M \qquad [2.24]$$

where: $V = (d/Z)^2$, $\delta = n/N$

$$V_1 = \left(\sum_{j=1}^{n} M^2 (\bar{y}_j - \frac{\bar{\bar{Y}}}{Y})^2\right) / \; n - 1$$

$$V_2 = \left(\sum_{j=1}^{n} s_j^2\right) / \; n$$

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[11] This procedure is the same as that used by the roadside analysis to solve for the sample sizes. Refer back to equation 2.11.

m = new sample size at the desired precision and alpha levels

M = total number of households

n = number of clusters sampled

N = total number of clusters in the summer sampling period

$\bar{y}_j$ = adjusted mean total hours of recreation per household in the j^{th} cluster

s_j^2 = variance for the adjusted mean total hours of recreation per household in the j^{th} cluster

$\hat{\bar{Y}}$ = combined adjusted population mean estimate of the total hours of recreation per household

V = adjusted variance to reflect the desired precision and alpha levels

d = desired precision in terms of the estimate

z = standard normal deviate corresponding to the allowable probability that the error will exceed the desired probability

One problem of using this equation to solve directly for the new sample sizes resulted from solving the equation while fixing the number of clusters at two. Although two clusters were sampled during the household survey, the optimum number of clusters sampled depends on the desired precision levels. Since an optimum solution (i.e., minimum sample size at each precision level) was desired, the equation should solve for the cluster sizes and sample sizes at the optimum level. This creates a situation where one equation is used to solve for two unknowns. An infinite number of solutions are possible without identifying the

minimum solution. Therefore, an iterative procedure was used to fix the cluster sizes at the feasible levels and solve for the sample sizes. For each level of precision the minimum sample size was selected.

Once sample sizes were determined for each precision level, confidence intervals using equation 2.10 were developed for each precision level at both the confidence levels.

Sample Size Comparison

The methodology described in this chapter outlines the procedures for determining the sample size estimates for both survey techniques in each study area. The reason for using two survey techniques was to compare the recreation participation from recreationists living outside the study areas with the recreation participation from people living in the study areas. The comparison is based on the sample size estimates determined from the total use estimates for each survey technique in both study areas. The results of the comparison coupled with the analysis of the sample sizes determined for each study area will be used to recommend a procedure for determining sample size estimates for future SCORP surveys designed to produce recreation participation estimates useful to the BLM. This section outlines the procedure used to adjust the sample size estimates from each survey technique for a meaningful comparison.

To compare the sample sizes from the two survey techniques, the recreation participation data must measure the same component of recreation participation in common units. The methodology adopted in this chapter produces recreation participation estimates from both survey techniques in common units (i.e., hours and visitor days) and presents

the sample size estimates based on recreation participation information supplied by the respondents. Both survey techniques develop sample size estimates using the analysis of the variable total hours of recreation participation.

The principle component of this analysis is the determination of the population mean estimate for the total hours of recreation participation per trip for each household in the population. In this analysis the sample size estimates were calculated for each survey technique using statistics from variables measuring recreation participation in identical units. The estimated sample sizes were determined at the same precision and confidence levels to allow for direct comparison. But the sample sizes produced for each survey still reflected a different component of recreation participation. The roadside survey described recreation participation from residents of Colorado living outside the study areas, while the household survey concentrated on those residents living inside the study areas. Therefore, the roadside sample size estimates were adjusted to calculate sample size estimates reflecting recreation participation by households living inside the study area. Two values were needed to determine the sample sizes: (1) the propensity of a household living in the study area to visit the study area, and (2) the total number of households residing in the study area. The propensity was determined by assigning the residents of the study area a propensity value equal to the residents of the counties surrounding the study area. This conservative estimate of the actual propensity was based on the assumption that the residents of the study area county would visit their county at least as much as the residents from adjacent counties. The total population of households in each study area was determined from

information obtained from the Mountain Bell Telephone Company. Using the total number of households and the assigned propensities, the number of telephone calls (sample size) allocated to each study area was ascertained. This produced an estimate of the sample sizes necessary to obtain recreation participation data at various degrees of precision and confidence for residents of the study areas. The estimated household sample sizes from each survey technique represent estimates based on the same population, but were determined using two different methods of data collection. A discussion of the results of this procedure are presented in the last section of the next chapter, including: (1) the comparison between the estimated sample sizes calcuated for each survey technique; (2) the relationship between the sample sizes for each study area; and (3) the recommended procedure for determining statewide sample sizes for future SCORP surveys collecting recreation participation data useful to the BLM at specified precision and confidence levels.

CHAPTER III. ANALYSIS AND RESULTS

This chapter applies the methodology of the preceding chapter to: (1) describe the recreation participation data collected during the two field surveys; (2) develop the total recreation use estimates for both study areas using each survey technique; (3) calculate the sample sizes for different precisions and confidence levels; (4) analyze the roadside and household estimates to develop the sample sizes for a statewide household survey; and (5) describe the relationship between the two surveys and study areas. The first section presents the results of the roadside traffic-stop survey component of the research. The household survey analysis and subsequent calculations are described in the second section. The last section combines the results from both surveys to describe their relationships.

Roadside Survey

The roadside survey technique measured the recreation participation of recreationists who visited the two studied Counties, but live outside those Counties. This section presents for both Counties the roadside survey use data and analysis of total recreation use and sample sizes as outlined in the strategy for analysis of the roadside data section in the previous chapter.

Sample Data Results

The sample data gathered during the roadside survey have been organized into a series of tables to summarize the recreation participation

information from Rio Blanco and Gunnison Counties and illustrate useful disaggregations.

Table 4 shows the number of in-state, out-of-state, and total interviews. Rio Blanco County was expected to provide fewer recreation opportunities and exhibit lower levels of use than Gunnison County. This expectation is confirmed by the smaller percentage of recreation to total interviews collected during the sampling. Only 14% of the total interviews in Rio Blanco County were recreation interviews while Gunnison had 37% recreation interviews.

The number of sampling days and interviews at each interview station is presented in table 5. Rio Blanco County was sampled more times since a smaller percentage of the total interviews were recreation interviews. The Cottonwood station in Gunnison County and the Pyramid station in Rio Blanco County were both surrounded by national forest land, which explains the higher percentage of recreation interviews gathered from these stations than other stations in the study areas.

Tables 6 and 7 describe the recreation participation by specific activities. The first column in each table (table 6 for Rio Blanco County and table 7 for Gunnison) shows the number of vehicles stoppped in which the respondent indicated that someone in the vehicle had recreated in the activity specified anywhere in the study area. Eighty-three vehicles were stopped in which at least one person in each vehicle participated in sightseeing in Rio Blanco County. This represented recreation participation by fifty-five percent of the total respondents recreating. The third column in tables 6 and 7 presents the same information, but only for the vehicles containing people who recreated in an activity in zones (refer to maps of the study areas on

Table 4. Number of respondents (Roadside survey, summer 1977).

County	Sample	All Interviews		Rec. Interviews (Only)		
		Number	Percent[a]	Number	Percent[a]	Percent[b]
Rio Blanco	Total sample	1,059	100	152	14	100
	In-state sample	586	55	92	9	61
	Out-of-state sample	473	45	60	6	39
Gunnison	Total sample	835	100	311	37	100
	In-state sample	358	43	109	13	35
	Out-of-state sample	477	57	202	24	65

[a]Calculated using the total sample size in the denominator.

[b]Calculated using the total recreation interviews in the denominator.

Table 5. Number of respondents by interview station (Roadside survey, summer 1977).

County	Station	Number of sampled days	Total number of interviews	Total number of rec. interviews
Rio Blanco	Rio Blanco	8	369	72
	Pyramid	2	16	5
	Ninemile	7	294	30
	Rangley	7	269	19
	Douglas Pass	5	111	26
	TOTAL	29	1,059	152
Gunnison	Somerset	2	74	18
	McClure	3	87	33
	Cottonwood	2	34	24
	Monarch	5	237	96
	West Pass	2	41	16
	Lake City	2	58	17
	Blue Mesa	6	304	107
	TOTAL	22	835	311

Table 6. Sample recreation participation totals by activity (Rio Blanco County, roadside survey, summer 1977).

Activity	All zones		Total for zones containing BLM land		
	Number[a]	Percent[b] (n=152)	Number[a]	Percent[b] (n=152)	Percent[c] (n=139)
Boating- lake	1	1	1	1	1
Boating- river	0	0	0	0	0
Camping near auto	29	19	23	15	17
Camping away from auto	6	4	2	1	1
Fishing	34	22	25	16	18
Picnicking	18	12	17	11	12
Sightseeing	83	55	80	53	58
4-wheel driving	7	5	6	4	4
Motorcycling	4	3	4	3	3
Bicycling	1	1	1	1	1
Collecting	4	3	3	2	2
Hiking/walking	15	10	9	6	6
Mountain climbing	0	0	0	0	0
Horseback riding	2	1	1	1	1
Hunting	1	1	1	1	1
Wildlife viewing	17	11	14	9	10
Photography	19	13	15	10	11
Nature study	5	3	4	3	3
Rodeo/parade	19	13	19	13	14
Visiting	4	3	1	1	1
Other	11	7	11	7	8

[a]Number of vehicles in which respondent indicated someone in the vehicle recreated in listed activity.

[b]Calculated using total number of recreation interviews.

[c]Calculated using total number of recreation interviews where the recreation occurred in zones containing BLM land.

Table 7. Sample recreation participation totals by activity (Gunnison County, roadside survey, summer 1977).

Activity	All zones		Total for zones containing BLM land		
	Number[a]	Percent[b] (n=311)	Number[a]	Percent[b] (n=311)	Percent[c] (n=229)
Boating-lake	11	4	8	3	3
Boating-river	2	1	1	0	0
Camping near auto	123	40	76	24	33
Camping away from auto	4	1	1	0	0
Fishing	112	36	62	20	27
Picnicking	49	16	26	8	11
Sightseeing	233	75	169	54	74
4-wheel driving	19	6	9	3	4
Motorcycling	10	3	3	1	1
Bicycling	2	1	0	0	0
Collecting	12	4	2	1	1
Hiking/walking	76	24	30	10	13
Mountain climbing	0	0	0	0	0
Horseback riding	10	3	2	1	1
Hunting	0	0	0	0	0
Wildlife viewing	43	14	16	5	7
Photography	84	27	48	15	21
Nature study	12	4	4	1	2
Roder/parade	0	0	3	1	1
Visiting	6	2	4	1	2
Other	30	10	9	3	4

[a]Number of vehicles in which respondent indicated someone in the vehicle recreation in listed activity.

[b]Calculated using total number of recreation interviews.

[c]Calculated using total number of recreation interviews where the recreation occurred in zones containing BLM land.

pages 18 and 19) with BLM land. In those zones the only federal land is administered by the BLM (except zone C in Gunnison County where the Park Service manages the Curecanti National Recreation Area). Therefore, most of the recreation taking place in zones with BLM land can be assumed to be occurring on BLM land. In the zones containing BLM land the activities most frequently mentioned during the interviewing were sightseeing, camping, and fishing. The percentages in these tables do not add to 100 since many of the recreationists participated in more than one activity.

The data in tables 8 and 9 represent a detailed disaggregation of the activity information from the sample data. The activity participation frequency data were broken down by zone (from figures 2 and 3) for each study area. This information is useful for determining specific areas of high and low recreation participation in each study area.

During each recreation interview the respondent was asked to indicate which activity was most important as a reason for visiting the study area. This information is summarized for each study area in the first column in tables 10 and 11. The third column shows the number of vehicles in which at least one person in the vehicle recreated in a specific activity in zones containing BLM land, and the respondent indicated that activity was the most important reason for visiting the area. In both tables, the rodeo/parade, visiting friends and relatives, and other categories of activities were summarized into a large other category since this information could not be identified by the individual most important activity.

Other questions included on the roadside survey questionnaire solicited information about the vehicle the respondent was driving,

Table 8. Sample recreation participation totals by activity for individual zones (Rio Blanco County, roadside survey, summer 1977).

ACTIVITY	Zone A			Zone B			Zone C			Zone D			Zone E			Zone F		
	N[a]	Percent[b] (n=152)	Percent[c] (n=37)	N[a]	Percent[b] (n=152)	Percent[c] (n=29)	N[a]	Percent[b] (n=152)	Percent[c] (n=16)	N[a]	Percent[b] (n=152)	Percent[c] (n=71)	N[a]	Percent[b] (n=152)	Percent[c] (n=59)	N[a]	Percent[b] (n=152)	Percent[c] (n=23)
Boating-lake	-			-			-			-			1	1	2	-		
Boating-river	-			-			-			-			-			-		
Camping near auto	2	1	5	-			4	3	25	5	3	7	12	8	20	6	4	26
Camping away from auto	-			-			-			-			2	1	3	4	3	17
Fishing	1	1	3	-			3	2	19	3	2	4	18	12	31	9	6	39
Picnicking	1	1	3	1	1	3	3	2	19	3	2	4	9	6	15	1	1	4
Sightseeing	33	22	89	29	19	100	10	7	63	40	26	56	38	25	64	13	9	57
4-wheel driving	-			-			2	1	13	1	1	1	4	3	7	3	2	13
Motorcycling	1	1	3	1	1	3	-			1	1	1	2	1	3	1	1	4
Bicycling	-			-			-			-			1	1	2	-		
Collecting	1	1	3	2	1	7	-			-			-			1	1	4
Hiking/walking	-			-			3	2	19	-			6	4	10	7	5	30
Mountain climbing	-			-			-			-			-			-		
Horseback riding	-			-			-			1	1	1	-			1	1	4
Hunting	-			-			-			-			1	1	2	-		
Wildlife viewing	1	1	3	1	1	3	3	2	19	1	1	1	10	7	17	6	4	26
Photography	3	2	8	6	4	21	3	2	19	1	1	1	8	5	14	5	3	22
Nature study	1	1	3	2	1	7	-			1	1	1	2	1	3	2	1	9
Rodeo/parade	-			-			-			19	13	27	-			-		
Visiting	-			-			-			1	1	1	-			-		
Other	2	1	5	3	2	10	-			7	5	10	1	1	2	1	1	4

[a]Number of vehicles in which respondent indicated someone in the vehicle recreated in the listed activity in the specified zone.

[b]Calculated using total number of recreation interviews.

[c]Calculated using total number of recreation interviews where the recreation occurred in specified zone.

Table 9. Sample recreation participation totals by activity for individual zones (Gunnison County, roadside survey, summer 1977).

ACTIVITY	Zone A			Zone B			Zone C			Zone D			Zone E			Zone F			Zone G		
		Percent			Percent			Percent			Percent			Percent			Percent			Percent	
	N[a]	(n=311)[b]	(n=59)[c]	N[a]	(n=311)[b]	(n=35)[c]	N[a]	(n=311)[b]	(n=195)[c]	N[a]	(n=311)[b]	(n=119)[c]	N[a]	(n=311)[b]	(n=61)[c]	N[a]	(n=311)[b]	(n=45)[c]	N[a]	(n=311)[b]	(n=134)[c]
Boating-lake	-			1	0	3	6	2	3	1	0	1	-			2	1	4	1	0	1
Boating-river	-			-			1	0	1	-			-			-			2	1	1
Camping near auto	5	2	8	8	3	23	66	21	34	10	3	8	13	4	21	12	4	27	41	13	31
Camping away from auto	-			-			-			1	0	1	1	0	2	1	0	2	1	0	1
Fishing	6	2	10	11	4	31	52	17	27	9	3	8	11	4	18	12	4	27	46	15	34
Picnicking	3	1	5	6	2	17	20	6	10	5	2	4	1	0	2	6	2	13	24	8	18
Sightseeing	54	17	92	23	7	66	150	48	77	109	35	92	52	17	85	40	13	89	113	36	84
4-wheel driving	3	1	5	3	1	9	5	2	3	3	1	3	4	1	7	3	1	7	10	3	7
Motorcycling	1	0	2	-			3	1	2	1	0	1	2	1	3	1	0	2	6	2	4
Bicycling	-			-			-			-			-			-			-		
Collecting	1	0	2	1	0	3	2	1	1	1	0	1	1	0	2	3	1	7	7	2	5
Hiking/walking	4	1	7	3	1	9	26	8	13	4	1	3	12	4	20	19	6	42	34	11	25
Mountain climbing	-			-			-			-			-			-			-		
Horseback riding	-			-			2	1	1	-			-			4	1	9	5	2	4
Hunting	-			-			-			-			-			-			-		
Wildlife viewing	2	1	3	2	1	6	12	4	6	4	1	3	5	2	8	10	3	22	23	7	17
Photography	3	1	5	5	2	14	44	14	23	8	3	7	11	4	18	17	5	38	44	14	33
Nature study	2	1	3	2	1	6	4	1	2	2	1	2	1	0	2	4	1	9	6	2	4
Rodeo/parade	-			-			4	1	2	-			-			3	1	7	4	1	3
Visiting	-			1	0	3	4	1	2	1	0	1	1	0	2	1	0	2	1	0	1
Other	2	1	3	3	1	9	8	3	4	3	1	3	-			5	2	11	9	3	7

[a]Number of vehicles in which respondent indicated someone in the vehicle recreated in the listed activity in the specified zone.

[b]Percent calculated using total number of recreation interviews.

[c]Percent calculated using total number of recreation interviews where the recreation occurred in the specified zone.

Table 10. Most important activity (Rio Blanco County, roadside survey, summer 1977).

Activity	All zones		Total for zones containing BLM land	
	Number[a]	Percent[b] (n=143)	Number[a]	Percent[c] (n=109)
Boating-lake	0	0	0	0
Boating-river	0	0	0	0
Camping near auto	8	6	7	6
Camping away from auto	5	3	2	2
Fishing	20	14	14	13
Picnicking	6	4	6	6
Sightseeing	62	43	60	55
4-wheel driving	0	0	0	0
Motorcycling	1	1	1	1
Bicycling	1	1	0	0
Collecting	1	1	1	1
Hiking/walking	0	0	0	0
Mountain climbing	0	0	0	0
Horseback riding	1	1	0	0
Hunting	1	1	1	1
Wildlife viewing	4	3	0	0
Photography	0	0	0	0
Nature study	0	0	0	0
Other	33	23	17	16

[a]Number of vehicles in which respondent indicated on activity was most important as a reason for visiting the area.

[b]Calculated using total number of respondents answering the question.

[c]Calculated using total number of respondents answering the question who recreated in those activities in zones containing BLM land.

Table 11. Most important activity (Gunnison County, roadside survey, summer 1977).

Activity	All zones		Total for zones containing BLM land	
	Number[a]	Percent[b] (n=287)	Number[a]	Percent[c] (n=176)
Boating-lake	2	1	1	1
Boating-river	1	1	1	1
Camping near auto	36	13	23	13
Camping away from auto	1	1	0	0
Fishing	62	22	36	20
Picnicking	3	1	2	1
Sightseeing/auto driving	153	53	108	61
4-wheel driving	5	2	3	2
Motorcycling	2	1	0	0
Bicycling	0	0	0	0
Collecting	0	0	0	0
Hiking/walking	1	1	0	0
Mountain climbing	0	0	0	0
Horseback riding	1	1	0	0
Hunting	0	0	0	0
Wildlife viewing	0	0	0	0
Photography	2	1	1	1
Nature study	0	0	0	0
Other	18	6	1	1

[a]Number of vehicles in which respondent indicated one activity was most important as a reason for visiting the area.

[b]Calculated using total number of respondents answering the question.

[c]Calculated using the total number of respondents answering the question who recreated in those activities in zones containing BLM land.

whether or not a trailer was being towed, whether the vehicle was two or four-wheel drive, and how many miles the respondent traveled on unpaved roads. Tables 12 and 13 present this information for both study areas based on interviews with all the respondents and with those who indicated someone in their vehicle had recreated in zones containing BLM land. Over 50 percent of the vehicles stopped in each study area were two-wheel drive passenger cars. It is interesting to note that 30 percent of the vehicles stopped in Gunnison County had driven more than 25 miles on unpaved roads. The Gunnison survey did not sample many visitors who had recreated in either the Powderhorn Primitive Area or the West Elks Wilderness Area. Either the use rates in these areas are low or the survey design adopted for this study excluded those recreationists.

The sex and ages of the recreationists visiting each study area are displayed in tables 14 and 15. The interviewers recorded the sex and estimated the ages of all the people in each vehicle according to the divisions shown in the left hand column of each table. Therefore, the total number and percentage columns are based on the total number of people in all the vehicles sampled and not just the number of vehicles. This table also shows the recreationists visiting zones containing BLM land.

The number of people riding in each vehicle stopped is expressed in tables 16 and 17. The values found in the two columns, labeled number, in each table represent the number of times a 1-person, 2-person, etc. vehicle was stopped for an interview.

Table 12. Miscellaneous question totals (Rio Blanco County, roadside survey, summer 1977).

Question	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=152)	Number[a]	Percent[c] (n=139)
Vehicle type				
Car	82	54	75	54
Truck	28	18	26	19
Van	8	5	7	5
Camper	15	10	12	9
Motorhome	7	5	7	5
Motorcycle	4	3	4	3
Jeep	8	5	8	6
Trailer type				
Utility	4	3	4	3
Camper	9	6	7	5
No trailer	139	91	128	92
Two or four wheel drive				
2 x 4	131	86	119	86
4 x 4	21	14	20	14
Number of miles driving on unpaved roads				
None	109	72	108	78
<10	12	8	8	6
10-25	11	7	8	6
>25	20	13	15	10

[a]Number of vehicles in which respondent indicated specified answer.

[b]Calculated using the total number of recreation interviews.

[c]Calculated using the total number of recreation interviews where the recreation occurred in zones containing BLM land.

Table 13. Miscellaneous question totals (Gunnison County, roadside survey, summer 1977).

Question	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=311)	Number[a]	Percent[c] (n=229)
Vehicle Type				
Car	157	51	118	51
Truck	32	10	18	8
Van	29	9	19	8
Camper	43	14	34	15
Motorhome	20	6	19	8
Motorcycle	8	3	6	3
Jeep	22	7	15	7
Trailer Type				
Utility	13	4	10	4
Camper	31	10	25	11
No trailer	267	86	194	85
Two or Four Wheel Drive				
2 x 4	277	89	207	90
4 x 4	34	11	22	10
Wilderness Areas				
Powerhorn	3	1	3	1
West Elk	2	1	2	1
Did not visit wilderness	306	98	224	98
Number of miles driving on unpaved roads				
None	146	47	133	58
<10	35	11	16	7
10-25	36	12	22	10
>25	94	30	58	25

[a]Number of vehicles in which respondent indicated specified answer.

[b]Calculated using the total number of respondents sampled.

[c]Calculated using the total number of respondents sampled who recreated in zones containing BLM land.

Table 14. Sex/Age breakdown of recreationists (Rio Blanco County, roadside survey, summer 1977).

Sex/Age	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=407)	Number[a]	Percent[c] (n=340)
Male < 15	41	10	37	11
Female < 15	42	10	40	12
Male 16-20	9	2	8	2
Female 16-20	5	1	5	1
Male 21-45	128	32	80	24
Female 21-45	81	20	76	22
Male > 45	50	12	47	14
Female > 45	51	13	47	14

[a]Number includes all people in the vehicle with the respondent.

[b]Calculated using total number of people whose ages were estimated.

[c]Calculated using total number of people whose ages were estimated who recreated in zones containing BLM land.

Table 15. Sex/Age breakdown of recreationists (Gunnison County, roadside survey, summer 1977).

Sex/Age	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=809)	Number[a]	Percent[c] (n=602)
Male < 15	84	10	65	11
Female < 15	97	12	71	12
Male 16-20	33	4	23	4
Female 16-20	22	3	19	3
Male 21-45	184	23	133	22
Female 21-45	162	20	119	20
Male > 45	118	15	90	15
Female > 45	109	13	82	14

[a]Number includes all people in the vehicle with the respondents.

[b]Calculated using total number of people whose ages were estimated.

[c]Calculated using total number of people whose ages were estimated who recreated in zones containing BLM land.

Table 16. Number of people in each vehicle (Rio Blanco County, roadside survey, summer 1977).

Number of people in vehicle	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=152)	Number[a]	Percent[c] (n=139)
1	31	20	27	19
2	77	51	71	51
3	16	11	15	11
4	17	11	16	12
5	2	1	2	1
6	5	3	4	3
7	4	3	4	3

[a]Number of respondents indicating specified carload size.

[b]Calculated using the total number of recreation respondents interviewed.

[c]Calculated using the total number of recreation respondents interviewed using zones containing BLM land.

Table 17. Number of people in each vehicle (Gunnison County, roadside survey, summer 1977).

Number of people in vehicle	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=311)	Number[a]	Percent[c] (n=229)
1	54	17	38	17
2	133	43	97	42
3	58	19	44	19
4	45	14	32	14
5	12	4	10	4
6	6	2	6	3
7	3	1	2	1

[a]Number of respondents indicating specified carload size.

[b]Calculated using the total number of respondents interviewed.

[c]Calculated using the total number of respondents interviewed using zones containing BLM land.

Estimates of Total Recreation Use

The preceding section summarized the survey data during the roadside survey. While the information was useful for describing the types, amounts, and locations of the recreation participation of the sampled respondents, it gives no information about the total amount or degree of variability of the recreation participation taking place. In this section, the calculations of the estimates of total recreation use are presented using the procedures outlined earlier. Two separate, but identical, analyses were performed for each study area. The first analysis used the sample data from all the interviews, while only the in-state interviews (those people interviewed who live outside the study area but inside Colorado) were used for the second analysis. The estimates produced from the in-state data were used to determine the sample size estimates described in the next section.

Estimates of total recreation use were based on the hours of recreation participation indicated by the sampled respondents during the roadside interviews. Reasons for selecting this variable (i.e., hours of recreation participation) and the procedure used to calculate the total hours of recreation participation per vehicle were already discussed on pages 29 and 30. Using the information collected during each interview period, the mean number of total hours of recreation per vehicle was calculated for each sampled day at each station using equation 2.1. The results of these calculations are shown for each study area in tables 18 and 19. The figures aligned along the same row represent the calculations from one sampled day. The sample variances from equation 2.2 associated with the mean are shown next to each mean value. The degree of variability between the sampled days for individual

Table 18. Sample means and variances from interview days (Rio Blanco County, roadside survey, summer 1977).

Station	Total sample			In-state sample		
	Mean[a]	Variance[b]	n[c]	Mean[a]	Variance[b]	n[c]
Rio Blanco	.41	2.35	39	8.0	1.59	19
	8.32	2,214.91	53	11.92	3,155.24	37
	6.56	265.70	85	9.21	9.21	58
	36.53	9,263.30	60	46.64	11,399.67	47
	1.55	17.26	31	.22	.89	18
	22.30	5,135.07	43	23.3	5,898.64	20
	.25	2.0	32	0	0	20
	6.38	442.89	26	16.0	9.6	16
Pyramid	56.22	28,196.44	9	56.22	28,196.44	9
	4.29	53.90	7	1.67	7.07	6
Ninemile	1.43	43.57	42	3.28	46.29	28
	1.93	68.94	40	.87	9.03	23
	0	0	57	0	0	35
	5.40	521.73	40	7.2	688.23	30
	26.67	15,106.81	39	12.32	3,314.56	25
	.16	.51	38	.26	.84	23
	.63	7.37	38	.25	1.0	16
Rangley	.80	4.86	30	.73	5.82	11
	1.82	73.09	33	4.29	168.53	14
	1.12	46.56	50	0	0	17
	3.46	305.52	50	0	0	13
	0	0	43	0	0	11
	.47	3.41	34	.53	5.25	19
	.14	.55	29	0	0	13
Douglas Pass	1.04	9.41	23	.29	1.14	14
	.84	4.58	19	1.2	7.29	10
	1.12	4.69	25	.75	3.13	16
	7.45	379.10	20	22.67	1,541.33	3
	1.21	6.35	24	.93	6.21	15

[a]Mean number of hours of total recreation per vehicle for that day.

[b]Variance for the mean.

[c]Sample interviews for that day.

Table 19. Sample means and variances from interview days (Gunnison County, roadside survey, summer 1977).

Station	Total sample			In-state sample		
	Mean[a]	Variance[b]	n[c]	Mean[a]	Variance[b]	n[c]
Somerset	4.15	138.26	33	.80	3.31	15
	18.24	3,486.24	41	8.6	1,071.21	30
McClure	13.27	1,878.12	41	5.29	535.99	27
	10.04	1,034.57	27	3.67	91.10	15
	55.28	16,060.33	18	108.75	32,732.79	8
Cottonwood	77.18	54,073.03	17	10.29	740.57	7
	189.06	74,872.55	17	66.89	4,968.11	9
Monarch	28.56	15,796.97	54	49.91	36,503.08	23
	44.54	17,661.32	61	53.52	18,297.33	29
	24.89	2,339.64	36	16.5	465.56	18
	58.41	12,563.67	39	27.14	1,415.81	7
	35.28	9,808.77	47	25.00	2,218.42	20
West Pass	13.78	1,186.89	18	6.08	151.72	12
	64.17	20,026.51	23	.67	4.0	9
Lake City	4.67	252.41	24	.53	2.55	15
	3.32	47.32	34	2.69	35.23	13
Blue Mesa	22.79	2,321.83	48	18.95	1,421.94	19
	36.10	12,339.54	59	4.53	128.26	17
	16.28	2,228.83	46	9.71	679.91	14
	39.63	4,448.79	48	57.6	8,069.16	10
	23.38	6,803.67	61	25.71	5,543.62	28
	133.45	67,067.72	42	35.38	6,593.59	13

[a]Mean number of hours of total recreation per vehicle for that day.

[b]Variance for the mean.

[c]Sample interviews for that day.

stations was larger in the Rio Blanco data than the Gunnison data. This indicated that the average amount of time spent recreating by the people in each vehicle in Rio Blanco County tended to vary further from the mean value compared to the recreation participation in Gunnison County. The sample mean values (total and in-state) for Gunnison County in table 19 are higher than the sample mean values shown for Rio Blanco County (table 18). These data support the selection of Gunnison County as an area of high recreation opportunity and high levels of recreation use relative to Rio Blanco County.

The next step in the calculation of total use estimates used the sample means and variances from all the sampled days at each station to develop a population mean and variance estimate for each station. The statistical procedures (equations 2.3 and 2.4) required that the total population (i.e., total traffic) for each station be known and the sample data reflect the recreation participation for a whole day.

Table 20 shows the estimates of total traffic leaving each study area by interview station. The estimates did not include commercial traffic, since the people operating commercial vehicles were assumed not to be participating in any recreation. The estimates for Gunnison County show that three times the amount of traffic was leaving that area compared to Rio Blanco County. Rio Blanco had a higher percentage of in-state to total traffic visiting the area.

Using the sample means and variances from tables 18 and 19 and the total traffic estimates from table 20, the estimated population means and variances for each station were calculated using equations 2.3 and 2.4. The results of these calculations are shown in table 21.

Table 20. Total summer traffic estimates for each station (Roadside survey, summer 1977).

County	Station	Estimated total traffic[a]	Estimated total in-state traffic[a]
Rio Blanco	Rio Blanco	40,079	23,177
	Pyramid	4,428	4,004
	Ninemile	31,196	19,789
	Rangley	36,355	15,818
	Douglas Pass	16,232	8,994
	TOTAL	128,290	71,782
Gunnison	Somerset	51,513	35,420
	McClure	19,558	11,781
	Cottonwood	12,744	7,315
	Monarch	105,952	47,478
	West Pass	14,438	5,005
	Lake City	27,797	13,860
	Blue Mesa	106,863	42,029
	TOTAL	388,865	162,888

[a]Figures do not include commercial traffic which was not considered eligible for sampling.

Table 21. Estimated means and variances for each station across all interview days (Roadside survey, summer 1977).

County	Station	Total Sample		In-state Sample	
		Mean[a]	Variance[b]	Mean[a]	Variance[b]
Rio Blanco	Rio Blanco	10.2	17.38	15.5	40.57
	Pyramid	28.7	676	30.0	741
	Ninemile	6.05	16.67	3.54	3.9
	Rangley	1.16	.212	1.22	3.76
	Douglas Pass	2.29	1.43	2.7	5.04
Gunnison	Somerset	14.6	72.93	7	3.77
	McClure	11.6	201.2	27.8	737
	Cottonwood	140	3,016	45	713
	Monarch	38	40.1	34.6	53.9
	West Pass	48	477.4	2.75	6.43
	Lake City	3.88	4.15	1.58	1.13
	Blue Mesa	23.9	23.5	23	39

[a]Mean number of total hours of recreation per vehicle per station.

[b]Variance for the mean.

Table 22 shows the fractional weights calculated for each station using equation 2.5. A weighting scheme was used in the development of the total use estimates to insure that the population mean and variance estimates from each station represented the proper proportion of the total use estimate for the whole area. The weighting was based on historical data reflecting the proportion of total traffic passing by each station.

The overall stratified population mean, total, and variance estimates are delineated in table 23. The overall stratified mean estimate was calculated by equation 2.6 incorporating the station population estimates and weights. The variance for this mean was determined by equation 2.7. The total estimates reflect the total hours of recreation participation for all vehicles exiting each study area throughout the sampling period. The overall stratified total and variance estimates were calculated using equations 2.11 and 2.12.

The Gunnison variance for the mean estimate of the in-state recreation participation was a smaller percentage of the mean estimate than the variance percentage figure of the mean estimate for Rio Blanco County. This indicated that the estimates produced for Gunnison County were more precise or better than those produced for Rio Blanco County. All the estimates were calculated in visitor days (i.e., 1 visitor day equals 12 hours) and hours to provide useful information to managers. The sample size analysis uses the visitor day estimates, since these figures are numerically smaller and easier to handle.

Sample Size Determinations

The primary purpose of this study was to determine sample size

Table 22. Station weights from historical traffic data for each station (Roadside survey, summer 1977).

County	Station	Weight
Rio Blanco	Rio Blanco	.35
	Pyramid	.04
	Ninemile	.25
	Rangley	.23
	Douglas Pass	.13
		1.0
Gunnison	Somerset	.14
	McClure	.03
	Cottonwood	.08
	Monarch	.32
	West Pass	.05
	Lake City	.05
	Blue Mesa	.33
		1.0

Table 23. Total recreation participation estimates (Roadside survey, summer 1977).

County	Units[a]	Total recreation participation				Total in-state recreation participation			
		Mean[b]	Variance[c]	Total[d]	Variance[e]	Mean[b]	Variance[c]	Total[d]	Variance[e]
Rio Blanco	Hours	6.79	4.29	871,089	7.0606×10^{10}	7.68	6.68	551,286	3.44197×10^{10}
	Visitor days	.57	.03	72,591	4.903×10^{8}	.64	.05	45,941	2.39026×10^{8}
Gunnison	Hours	36.23	28.78	12,277,115	3.30479×10^{12}	24.57	15.6	4,002,158	4.13907×10^{11}
	Visitor days	3.02	.2	1,023,093	2.29687×10^{10}	2.048	.11	333,513	2.8743×10^{9}

[a]One visitor day equals 12 hours.

[b]Overall stratified mean estimate of the total number of hours of recreation per vehicle.

[c]Estimated variance for the mean.

[d]Estimated total hours of recreation participation for all non-commercial vehicles exiting the study area.

[e]Estimated variance for the total.

estimates for a statewide household telephone survey. The roadside traffic-stop survey technique measured recreation participation on-site, where the recreation occurred. The transformations of the sample sizes calculated from the roadside "destination" survey data to sample size estimates for a household origin study are discussed in this section. The procedure designed to accomplish this transformation include calculations of: (1) the estimated sample sizes at different levels of precision for a roadside survey; (2) the statewide sample sizes for a household origin survey; and (3) the statewide sample sizes for a household origin survey disaggregated by origin regions in Colorado. The sample size estimation procedure used only the in-state recreation participation data, since the sample estimates were calculated for a study designed to measure recreation participation from within Colorado.

Sample sizes for different levels of precision

The in-state mean, total, and variance estimates determined in the preceding section were used to calculate the level of precision and confidence limits for the sample data. By combining those estimates with the normal deviate figures at the .1 and .2 confidence levels, equation 2.10 was used to determine the level of precision of the data collected during the summer roadside surveys. The estimates for Rio Blanco and Gunnison Counties are presented in the first two rows of tables 24 and 25. In table 24 (row 1), there is a 90% probability (i.e., 1 - α level of confidence) that repeated samples of size 586 interviews obtained from roadside sampling in Rio Blanco County would provide a mean estimate within the limits of the values defined as ±57% of the .65 mean value. In units of the mean these values are expressed under the heading,

Table 24. Estimated sample sizes and confidence limits for different levels of precision and confidence (Rio Blanco County, roadside survey, summer 1977).

	Sample sizes						Confidence limits for the	
α Levels	Days	Interviews	Precision levels[a]	Mean estimate[b]	Variance[b]	Total estimate[b]	Mean estimate[c]	Total estimate[c]
.1	29	586	(±57%)[d]	.64	.05	45,940	(.28; 1.0)	(20,099; 72,097)
.2	29	586	(±44%)[d]	.64	.05	45,940	(.36; .92)	(25,842; 66,039)
.1	37	743	(±50%)	.64	.036	45,940	(.32; .96)	(22,970; 68,911)
.2	23	469	(±50%)	.64	.059	45,940	(.32; .96)	(22,970; 68,911)
.1[e]	115	2,329	(±25%)	.64	.009	45,940	(.48; .8)	(34,455; 57,426)
.2[e]	78	1,572	(±25%)	.64	.015	45,940	(.48; .8)	(34,455; 57,426)
.1[f]			(±10%)	.64	.002	45,940	(.58; .7)	(41,346; 50,534)
.2[e]	254	5,141	(±10%)	.64	.002	45,940	(.58; .7)	(41,346; 50,534)

[a]Defines the deviation on either side (above and below) of the mean and total estimates.

[b]All values are calculated in visitor days.

[c]Delineates the limits of the confidence intervals above and below the mean or total estimates.

[d]Actual estimated precision levels for the sample data at different α levels for the data collected during the summer survey.

[e]To obtain a sample this size, the sampling design would have to be modified to sample more than one station per day.

[f]Sample size necessary at this level is so large, that it cannot be achieved using this survey technique without major modifications in the sampling design.

Table 25. Estimated sample sizes and confidence limits for different levels of precision and confidence (Gunnison County, roadside survey, summer 1977).

α Levels	Sample sizes: Days	Sample sizes: Interviews	Precision levels[a]	Mean estimate[b]	Variance[b]	Total estimate[c]	Confidence limits for the: Mean estimate[c]	Confidence limits for the: Total estimate[c]
.1	22	358	(±28%)[d]	2.05	.11	333,513	(1.48; 2.62)	(241,074; 426,767)
.2	22	358	(±21%)[d]	2.05	.11	333,513	(1.62; 2.48)	(263,879; 404,743)
.1	8	125	(±50%)	2.05	.30	333,513	(1.02; 3.08)	(166,146; 501,695)
.2	5	78	(±50%)	2.05	.48	333,513	(1.02; 3.08)	(166,146; 501,695)
.1	25	421	(±25%)	2.05	.09	333,513	(1.54; 2.56)	(250,848; 416,993)
.2	15	257	(±25%)	2.05	.15	333,513	(1.54; 2.56)	(250,848; 416,993)
.1[e]	169	2,743	(±10%)	2.05	.02	333,513	(1.84; 2.26)	(299,714; 368,127)
.2[e]	98	1,588	(±10%)	2.05	.03	333,513	(1.84; 2.26)	(299,714; 368,127)

[a]Defines the deviation on either side (above and below) of the mean or total estimates.

[b]All values are calculated in visitor days.

[c]Delineates the limits of the confidence intervals above and below the mean or total estimates.

[d]Actual estimated precision levels for the sample data at different α levels for the data collected during the summer survey.

[e]To obtain a sample this size, the sample design would have to be modified to sample more than one station per day.

confidence limits for the mean estimate and calculated to be .28 and 1.0. Inspection of the Gunnison County estimates in table 25 (row 1) at the same confidence level indicates that the precision of the sample data was ±28% of the mean estimate.

Though the sample size for Gunnison County was smaller (358 versus 586) than that for Rio Blanco County, the level of precision associated with the estimates was better. This supports the statements made in the preceding section that the total hours of recreation participation for people recreating in Rio Blanco County tended to be more variable than for people recreating in Gunnison County. If a larger sample of recreationists were selected from Rio Blanco County, the precision of the estimates of recreation participation would increase by decreasing the expected deviations from the estimates calculated. Therefore, to produce estimates of recreation participation comparable to those measured in Gunnison County, the sample size in the Rio Blanco study would have to be increased. Calculations of the precision levels gives the interpreter the ability to compare the recreation use estimates for the two study areas by examining the ranges of expected deviations of the estimates in easily understood units.

Various ranges of sample sizes at specified precision levels (±50%, ±25%, and ±10% of the estimates) for the .1 and .2 alpha levels of confidence were calculated to illustrate how the sample sizes would vary if recreation use data at different levels of precision were desired. These calculations used equation 2.11 (refer to the explanation of the equation for the exact procedure). Tables 24 and 25 list the estimates determined for each study area in rows three through eight. This information should be interpreted as the sample sizes required to obtain

recreation participation estimates from each study area at the indicated levels of precision and confidence using the survey techniques of this study. The new sample sizes can be compared to the actual sample sizes (rows 1 and 2) acquired during the summer surveys to determine the trade-offs between better recreation use information versus the increased sample sizes necessary to acquire that data. For example if a manager in Gunnison County would like estimates of the mean to be at least twice as precise at the .2 confidence level as those collected during the 1977 summer survey, the sample size needed to attain this level would have to be almost five times the original sample size. This is shown in table 25 by comparing the sample sizes in row 2 to those in row 8. As better estimates are needed, the sample size increases.

At some precision levels (footnoted by an e or f in column 1 of each table) the sampling design of the roadside survey was not sufficient to acquire a sample size large enough to meet the calculated precision levels. The sampling technique would have to be modified to sample more recreationists. For example, the sample size needed for the ±10% precision level and the .1 alpha level for Rio Blanco County (table 24) could not be determined using the sampling scheme adopted for this study. In this instance the overall variance component for the mean and total use estimates could not be reduced to the level necessary to obtain a ±10% precision level, because the number of sample days needed to acquire the necessary number of sample interviews was greater than the number of available days. Even if the sampling scheme were modified to sample each station on each day of the sampling period, the necessary sample size could not be achieved. New interview stations and longer interview periods would have to be used to sample at the required levels. Since

no information was available describing the hours of recreation participation and the within and between components of variance for a new interview location, the sample size at the ±10% precision level for the .1 alpha level for Rio Blanco County could not be determined.

Statewide sample sizes

The sample sizes calculated in the last section were designed for a roadside traffic-stop destination survey. To transform these estimates into sample sizes for a household telephone origin survey, the propensity of a household in Colorado to visit each study area was needed. This was defined on page 45 in chapter II as the total household traffic visiting the study area divided by the number of households in the State. The traffic estimates are presented in table 20. The Mountain Bell Telephone Company estimated the number of households in Colorado having a telephone to be 896,759 (excluding Rio Blanco County) and 895,418 (excluding Gunnison County). The ratio of total traffic to households is outlined in table 26 for Rio Blanco County and table 27 for Gunnison County. The resulting ratio can be defined as the number of phone calls necessary to reach one household which visited the specific study area. For Rio Blanco County (table 26), a household visiting the study area was expected to be contacted every 12.5 calls. Equation 2.12 was used to calculate the sample size of telephone calls necessary statewide to implement a household origin survey that would produce recreation use estimates for each study area at precision levels specified

Table 26. Statewide sample needed for a household telephone survey (Rio Blanco County, summer 1977).

α Level	Precision level	Total traffic/number of households	Ratio[a]	Interviews needed	Number of completed calls needed[b]
.1	±57%	71,682/896,759	1/12.5	586	7,280[c]
.2	±44%	71,682/896,759	1/12.5	586	7,280[c]
.1	±50%	71,682/896,759	1/12.5	743	9,179
.2	±50%	71,682/896,759	1/12.5	469	5,740
.1	±25%	71,682/896,759	1/12.5	2,329	28,995
.2	±25%	71,682/896,759	1/12.5	1,572	19,656
.1	±10%[d]	71,682/896,759	1/12.5	-	-
.2	±10%	71,682/896,759	1/12.5	5,141	64,325

[a]Ratio defines the number of calls necessary to reach one household where someone visited Rio Blanco County.

[b]Calculated by multiplying the number of calls necessary to complete one interview where someone in the household visited Rio Blanco County by the total number of completed interviews necessary for each precision and confidence level.

[c]Number of calls necessary to acquire the sample size surveyed in the roadside destination survey (summer 1977).

[d]Sample of this size could not be determined using the survey design and procedures used for the roadside survey (i.e., sample size needed too large to obtain).

Table 27. Statewide sample needed for a household telephone survey (Gunnison County, summer 1977).

α Level	Precision level	Total traffic/number of households	Ratio[a]	Interviews needed	Number of completed called needed[b]
.1	±28%	162,888/895,418	1/5	358	2,021[c]
.2	±21%	162,888/895,418	1/5	358	2,021[c]
.1	±50%	162,888/895,418	1/5	125	778
.2	±50%	162,888/895,418	1/5	78	502
.1	±25%	162,888/895,418	1/5	421	2,620
.2	±25%	162,888/895,418	1/5	257	1,612
.1	±10%	162,888/895,418	1/5	2,743	15,498
.2	±10%	162,888/895,418	1/5	1,588	8,968

[a]Ratio defines the number of calls necessary to reach one household where someone visited Gunnison County.

[b]Calculated by multiplying the number of calls necessary to complete one interview where someone in the household visited Gunnison County by the total number of completed interviews necessary for each precision and confidence level.

[c]Number of calls necessary to acquire the sample size surveyed in the roadside destination survey (summer 1977).

in tables 24 and 25.[12] The statewide sample sizes for each precision level are shown in the right hand column of tables 26 and 27 for each study area. The first two entries in this column indicate the number of telephone calls necessary to obtain a sample equal in size to the sample obtained during the roadside destination survey. In Rio Blanco County if a precision level of ±25% at the .1 alpha level is desired, 28,995 telephone calls would be needed from the statewide household survey to reach 2,329 households that visited Rio Blanco County. At the same precision and alpha levels for Gunnison County, a total of 2,620 calls would be required to obtain the necessary 421 interviews.

Sample sizes by origin region

The statewide household origin survey sample size estimates delineated in tables 26 and 27 were considered too large an aggregation to sample accurately the recreation use in each study area at the desired precision levels. A telephone survey in Colorado conducted at the state level would select randomly a sample of households to be included in the sample. Since a large portion of the State's population lives along the front range between Pueblo and Ft. Collins, a high proportion of the interviews would be selected from that area. Further analysis of the roadside sample data indicated that the propensity of a person to visit the specified study area from the front range was considerably less than the propensity calculated for households residing in counties near the

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[12] Two assumptions were necessary when equation 2.12 was used to calculate the sample sizes.

(1) Each household only visited the specific study area once during the sampling period.

(2) Each household that visited the study area had a household telephone.

study area. Therefore, it was determined that the statewide sample sizes should be disaggregated to origin regions to reflect the "local" propensity of a household to recreate in each study area.

To be consistent with a survey design which might be implemented as part of a SCORP, the State was disaggregated into the thirteen SCORP regions shown in table 28. Each region consisted of the groups of counties outlined in table 28. The roadside sample sizes were considered too small to disaggregate to the county level. Table 29 outlines the number of roadside sample interviews and the total traffic estimates from each of the thirteen origin regions. Because some regions had a small number of observations (e.g., regions 5 and 6 from the Rio Blanco County data), it was decided that the regions should be aggregated one step further to provide enough sample data in each origin region to support the analysis. The criteria for aggregating to the final six regions (table 30) was described on page 47 in the preceding chapter. These six regions are outlined in table 30. Region A included all the counties east of the front range corridor area. Region B consisted of counties along the northern front range, while C incorporated the southern front range. Region D included counties from the southwest part of the State west of the front range to the Utah border. Region E included the counties in the vicinity of Gunnison (i.e., SCORP region 10). Region F aggregated counties along and to the west of the continental divide to the Utah border in the northern half of Colorado.

Table 31 indicates the number of sample interviews and estimated total traffic corresponding to each final origin region for both study areas. The number of household telephone numbers by origin region for each study area is shown in table 32. Using the information from these

Table 28. SCORP regional breakdowns (By county, summer 1977).

Region 1	Region 6	Region 10
Logan	Crowley	Delta
Morgan	Prowers	Gunnison
Washington	Bent	Montrose
Sedgwick	Kiowa	San Miguel
Phillip's	Otero	Ouray
Yuma	Baca	Hinsdale
Region 2	**Region 7**	**Region 11**
Larimer	Pueblo	Moffat
Weld	Huerfano	Rio Blanco
	Las Animas	Garfield
		Mesa
Region 3	**Region 8**	
Boulder		**Region 12**
Gilpin	Saguache	
Clear Creek	Mineral	Routt
Adams	Rio Grande	Jackson
Denver	Alamosa	Grand
Arapahoe	Conejos	Summit
Douglas	Costilla	Eagle
Jefferson		Pitkin
	Region 9	
Region 4		**Region 13**
	Dolores	
Park	Montezuma	Lake
Teller	San Juan	Chaffee
El Paso	LaPlata	Fremont
	Archuleta	Custer
Region 5		
Elbert		
Lincoln		
Kit Carson		
Cheyenne		

Table 29. In-state sample data and in-state estimated total traffic breakdown of visitors to the study areas by SCORP origin region (Roadside survey, summer 1977).

Region	Rio Blanco County		Gunnison County	
	Number of interviews[a]	Estimated total traffic[b]	Number of interviews[a]	Estimated total traffic[b]
1	5	647	3	1,315
2	24	3,041	9	3,926
3	101	12,791	120	54,876
4	13	1,586	32	14,414
5	1	93	2	895
6	1	99	4	1,855
7	5	510	22	10,127
8	4	508	9	4,249
9	9	1,149	2	656
10	41	4,664	107	48,700
11	341	41,636	25	11,384
12	35	4,416	6	2,728
13	6	642	17	7,763
TOTAL	586	71,782	358	162,888

[a]Number of sample interviews where the respondent indicated their trip originated in one of the listed regions.

[b]Estimated total traffic coming from the origin region to visit the study area.

Table 30. Regional aggregations of SCORP regions (Roadside survey, summer 1977).

Region	SCORP Regions
A	1, 5, 6
B	2, 3
C	4, 13, 7
D	8, 9
E	10
F	11, 12

Table 31. In-state sample data and in-state estimated total traffic breakdown of visitors to the study areas by aggregated origin regions (Roadside survey, summer 1977).

Region	Rio Blanco County		Gunnison County	
	Number of interviews[a]	Estimated total traffic[b]	Number of interviews[a]	Estimated total traffic[b]
A	7	839	9	4,065
B	125	15,832	129	58,802
C	24	2,738	71	32,304
D	13	1,657	11	4,905
E	41	4,664	107	48,700
F	376	46,052	31	14,112
TOTAL	586	71,782	358	162,888

[a]Number of sample interviews where the respondent indicated their trip originated in one of the listed regions.

[b]Estimated total traffic coming from the origin region to visit the study area during the summer season.

Table 32. Number of household telephone numbers in each region (Summer 1977).

Region	Rio Blanco County	Gunnison County
A	41,561	41,561
B	608,568	608,568
C	154,150	154,150
D	23,326	23,326
E	16,922	14,054
F	52,232	53,759
TOTAL	896,759[a]	894,418[a]

[a]The total number of household telephone numbers in Colorado, calculated by summing the totals for each region in each study area will not be equal because the household numbers from the study area county were not included. The roadside survey did not survey recreation participation from residents living in the study area.

two tables, the number of calls necessary from each origin region for a household telephone survey was determined utilizing equation 2.13. These final sample sizes (i.e., number of calls from each origin region at each precision and alpha level) are listed in tables 33 and 34 for Rio Blanco and Gunnison Counties.

As delineated in column 2 of table 34, the ratio of the households visiting the study area to the number of households residing in region E (counties surrounding Gunnison County) was one to one. Therefore, it must be assumed that each household visited the study area at least once during the summer, or some of the households had repeated visits to the appropriate study area. In this instance where the origin county was adjacent to the destination county, households in the origin county might visit the destination county more than once per summer. Although the sample sizes calculated at each precision and confidence level equal the number of interviews needed, the actual sample size of telephone calls necessary might be slightly higher due to repeated visits by some households. This was not a large problem in other regions.

The propensity of a household to recreate in one of the destination counties from the origin regions was an important component of the sample size determinations. In table 33, for example, the number of interviews needed from region F is three times that needed from region B, but the number of telephone calls needed to acquire the desired number of interviews was close to ten times larger in region B than in region F. This illustrates the point that sample sizes determined at the state level would misrepresent the actual sample needed in many areas of the State to obtain the desired precision and confidence levels from the estimate.

Table 33. Sample needed for a telephone survey by origin region (Rio Blanco County, summer 1977).

Region	Ratio[c]	α level	Sample data[a]		±50%		±25%		±10%[b]	
			Interviews needed	Number of calls necessary[d]	Interviews needed	Number of calls necessary[d]	Interviews needed	Number of calls necessary[d]	Interviews needed	Number of calls necessary[d]
A	1/50	.1	7	350	8	400	27	1,350	-	-
		.2	7	350	5	250	19	950	60	3,000
B	1/38	.1	125	4,674	162	6,156	514	19,532	-	-
		.2	125	4,674	103	3,914	345	13,110	1,135	43,130
C	1/56	.1	24	1,344	28	1,568	88	4,928	-	-
		.2	24	1,344	16	896	60	3,360	195	10,920
D	1/14	.1	13	182	18	252	53	742	-	-
		.2	13	182	12	168	37	518	118	1,652
E	1/4	.1	41	164	48	192	152	608	-	-
		.2	41	164	31	124	103	412	334	1,336
F	1/2	.1	376	752	479	958	1,495	2,990	-	-
		.2	376	752	302	604	1,008	2,016	3,299	6,598

[a]Precision levels for the sample data from the roadside survey were ±57% at the .1 α level and ±44% at the .2 α level.

[b]Sample size could not be determined using the survey design and procedures used during the roadside survey (i.e., sample size needed too large to obtain at the .1 α level).

[c]Ratio of the estimated total traffic from each region to the number of households in that region. Reflecting the number of calls necessary in that region to reach one household where someone visited the study area.

[d]Calculated by multiplying the traffic/household ratio by the number of interviews needed.

Table 34. Sample needed for a household telephone survey by origin region (Gunnison County, summer 1977).

Region	Ratio[b]	α Level	Sample data[a]		±50%		±25%		±10%	
			Interviews needed	Number of calls necessary[c]	Interviews needed	Number of calls necessary[c]	Interviews needed	Number of calls necessary[c]	Interviews needed	Number of calls necessary[c]
A	1/10	.1	9	90	3	30	9	90	70	700
		.2	9	90	2	20	6	60	39	390
B	1/10	.1	129	1,290	45	450	153	1,530	990	9,900
		.2	129	1,290	29	290	94	940	574	5,740
C	1/5	.1	71	355	25	200	82	656	543	2,715
		.2	71	355	17	136	51	408	315	1,575
D	1/5	.1	11	55	4	20	14	70	83	415
		.2	11	55	2	10	8	40	48	240
E	1/1	.1	107	107	38	38	126	126	820	820
		.2	107	107	22	22	76	77	475	475
F	1/4	.1	31	124	10	40	37	148	237	948
		.2	31	124	6	24	22	88	137	548

[a]Precision levels for the sample data from the roadside survey were ±28% at the .1 α level and ±21% at the .2 α level.

[b]Ratio of the estimated total traffic from each region to the number of households in that region, reflecting the number of calls necessary in that region to reach one household where someone visited the study area.

[c]Calculated by multiplying the traffic/household ratio by the number of completed interviews needed.

Data Limitations

The primary purpose of the roadside survey was to sample the recreation participation in the study areas by people who lived outside the study areas, to provide: (1) the sample data necessary to describe the recreation use during the 1977 summer season in each study area, and (2) the estimates of the sample sizes necessary to sample the recreation participation of the study areas using a household survey technique like the survey design employed by the SCORP.

The sample data analysis section presented a series of tables describing the recreation participation in each study area. Most of the data were presented as numbers and percents describing the recreation participation and recreation users by specific activities or categories. The vehicle was the primary unit of analysis since the sampling design specified a traffic-stop survey. To report the results on the basis of individual users would have necessitated blowing-up the recreation data by the number of individuals in each vehicle. This technique could lead to erroneous results because: (1) the number of people from each vehicle recreating in a specific activity or area is not known, and (2) the sample design specified a random sample of vehicles (to report data in any other unit would violate the randomness of the sampling design and introduce bias into the results). While a summary of the recreation participation by vehicles represented a less desirable and limited format for presenting data, it was felt that the accuracy of the summary statistics was more important than the format of the results.

The level of disaggregation selected for presenting the sample data and total use estimates represented another limitation on the applicability of the results of the roadside survey data. Ideally, the results

of the study could provide total use estimates by activity for specific sites. The primary purpose of the research was not to determine use estimates at those levels. The sample data analysis presented activity information specifying the recreation participation in all zones, only in zones containing BLM land, and in individual zones. The total use estimates were not disaggregated below the county level and did not include estimates by activity. To acquire this information the size of the study area would have had to be reduced, the sample sizes increased, and the questionnaire lengthened.

The estimates of total use calculated in this chapter provided a description of the total amount of recreation participation (in hours and visitor days) occurring in each study area during the summer sampling period and provided the mean, total, and variance estimates necessary for the calculation of the sample size estimates. The limitations associated with the interpretation and applicability of these estimates were primarily a function of the assumptions made during the development of the total use estimates. These assumptions are discussed below.

The first problem related to the estimation of the total traffic exiting each study area during the sampling period. When transforming the sample data gathered for a specific variable from a sample of a population to estimates of the population value for that variable, the total population should be known, not estimated. In this study the total population was defined as the total number of vehicles (i.e., total non-commercial traffic) exiting each study area during the sampling period. By defining the population in this manner, the researcher had to define a population value that was fluctuating constantly from day to day. Actual observations of the total traffic exiting each study area

on each day were not available. Therefore, using pneumatic traffic counters, observations during the interview periods, and vehicular volume estimates from the Colorado State Department of Highways, the traffic figures were estimated for each station for the sampling period. The following assumptions were made during the estimation of the total traffic and in-state total traffic.

(1) The proportion of commercial traffic to total traffic observed during an interview period remained constant for the non-sampled part of the day.

(2) The proportion of out-of-state to in-state traffic observed during the interview periods was assumed to remain constant for the rest of the day.

(3) The days selected for the sampling were representative of all days during the sampling period.

It should be noted that the estimates developed from the sampling for the percentage of total traffic exiting each station were consistent with historical estimates supplied by the State, but the actual population was not known. Therefore, the total recreation use figures were estimates calculated from estimates of the total population, and the variance estimates reflect only the variability of the variable (i.e., total hours of recreation participation) measured during the sampling and not the variability associated with the population estimate of the total traffic.

Another problem of the analysis dealt with the statistical design of the survey technique. The statistical procedures adopted to develop use estimates used a clustering procedure based on recreation use data from a whole day. The sampling design used in this study subsampled a

part of a day. Therefore, the data gathered during the interview period was extrapolated to a full day using the total traffic figures for that day. It was assumed that the interview periods selected during the sample design correctly represented the recreation use during those days. Four different interview time blocks were used for each station to sample different periods during each sampled day. If differences in recreation behavior existed at different times during the day, that time period would be represented in the sample. This sampling method was used since it was not economically practical and not safe to sample all hours during a day.

The sampling design adopted for this study specified stopping and interviewing the occupants of selected non-commercial vehicles exiting each study area during the interview period. There was no way to determine before a vehicle stopped whether the occupants had participated in any recreation activities. Consequently, the total use estimating procedure conformed to the sampling by incorporating the zeroes (i.e., a zero was recorded for all vehicles in which the respondent indicated no recreation participation) into the estimating procedure as a valid response. While this effectively lowered the mean value of the total hours of recreation participation per vehicle for the people who did recreate, it gave a better description of the recreation participation in the study area for each vehicle leaving that area. If traffic counters are used to help estimate the recreation use of an area, the estimates produced in this study give a good indication of the average amount of recreation use per vehicle for each study area. The total use estimates were unaffected by incorporating the zeroes into the analysis.

The sample size estimation procedure used the precision and confidence level calculations for the total use estimates from the roadside data to develop the sample sizes necessary to implement a household survey. The principal limiting factor in this procedure was the transformation of the sample size estimates produced at different precision levels for a roadside destination survey technique to sample sizes for a household origin survey. Three of the problems or limitations with this component of the analysis are discussed below.

First, the selection of the specific aggregated origin regions (used to structure the determination of the propensity of a household from an origin region to recreate in each destination study area) is reflected in the calculations of the propensities and therefore affected the estimates of the number of telephone calls necessary from each origin region. In some instances the origin regions selected were based on only a small number of sample interviews from the summer survey. Instead of continuing to aggregate and losing information from distinctive origin regions, it was assumed that the sampling was accurate and there were very few households from those regions visiting the study areas.

The second limitation involved the link between the roadside survey and the household origin survey for which the roadside survey sample sizes were developed. The roadside survey technique from which the original sample size estimates were derived, measures recreation use for the whole summer. The sample size estimates determined from the roadside data for the household telephone survey should also estimate the recreation use for the same time period. It is not known whether a person can recall recreation participation across a whole summer. This may

be a reasonable assumption for a specific destination, but to remember specific details from every trip anywhere in the State would be difficult.

The third limitation or problem is the influence on the sample size estimates of incorporating the zeroes into the estimates of recreation participation. The estimated household survey sample sizes reflect the number of calls necessary to reach a household where someone in that household visited one of the study areas during the summer. With the zeroes in the analysis the propensity calculations illustrate the propensity of a household to visit one of the study areas, not the propensity of a household to recreate in the study area. While this is not the most efficient sampling for recreation participation, the total use estimates calculated with this procedure will be exactly the same as the estimates produced if recreation participation were sampled directly. The biggest problem encountered in the inclusion of the zeroes in the sample sizes is the confusion involved with the interpretation of what the sample sizes represent. The major difference is that a zero is considered a valid response in this design.

While the information in this section does not invalidate the results of this study, the reader should be cognizant of the existence of the problems and limitations. Since this research was designed as a pilot study, there was no way of anticipating all the problems which would be encountered. The ramifications of the limitations are discussed in further detail in the last section of this chapter during the closing remarks about the connection between the roadside and household surveys.

Household Survey

The household survey was designed to measure the recreation participation of the residents of the two study areas during the summer season. The techniques and the methodology were discussed in the previous chapter. This section will present results of the analysis of the household survey data from both study areas. The format of the data presented and the sections used to describe the results are consistent with the structure used during the roadside survey analysis. The sections include: (1) sample data results; (2) estimates of total recreation use; (3) sample size determinations; and (4) data limitations.

Sample Data Results

Results of the random digit dialing technique

The total sample sizes calculated to sample recreation participation in each study area were determined using equations 2.16 and 2.17 on page 57. Tables 35 and 36 summarize the sample sizes by an allocation for each prefix and number bank servicing the study areas. Using equation 2.14 on page 52, the necessary number of interviews needed from each number bank was based on the total number of working household telephone numbers in each number bank. These values are recorded in the third column of table 35 for Rio Blanco County and table 36 for Gunnison County. Table 35 shows that number banks with larger numbers of household telephone numbers were allocated a larger sample size. This self-weighting procedure, based on the size of the number bank, effectively gave each telephone number in each study area the same chance of selection. The last two columns in each table show the number of telephone numbers dialed to obtain the required sample in each number

Table 35. Sample size allocations and total number of telephone numbers dialed in each number bank (Rio Blanco County, household survey, summer 1977).

Prefix and number bank	Number of households	Sample needed	Number of different phone numbers dialed[a]	
			RIO 1	RIO 2
657-2000	257	13	80	73
675-8000	326	17	90	71
878-4000	352	18	48	42
878-5000	533	27	62	42
TOTAL	1,468	75	280	228

[a]The first and second surveys are designated as RIO 1 and RIO 2.

Table 36. Sample size allocations and total number of telephone numbers dialed in each number bank (Gunnison County, household survey, summer 1977).

Prefix and number bank[a]	Number of households	Sample needed	Number of different phone numbers dialed[b]	
			GUN 1	GUN 2
641-3000	543	20	60	64
641-2000	494	21	36	56
641-1000	576	18	49	61
641-0000	534	20	55	59
349-5000	427	16	100	58
349-6000	47	2	20	41
929-(5-6000)	64	2	4	4
963-(2,3,5000)	31	1	6	5
TOTAL	2,716	100	330	348

[a]Prefixes 929 and 963 were operated by private telephone companies, which did not have as structured a system as Mountain Bell's. The numbers dialed in these prefixes were selected randomly from all the household numbers listed in the phone book.

[b]The first and second surveys are designated as GUN 1 and GUN 2.

bank. Since there were two survey periods in each study area, the number of different telephone numbers dialed were recorded in two separate columns. Table 35 specified Rio 1 for the first survey period and Rio 2 for the second. A comparable breakdown is illustrated in table 36 with Gun 1 and Gun 2 corresponding to the first and second survey periods for Gunnison County. In table 35 row 1, 80 different telephone numbers were dialed before the sample of 13 households could be obtained for the first survey period. So many numbers were required because, of the possible 1,000 numbers in the number bank, only 257 were working household telephone numbers. Number banks with a higher percentage of working household numbers required fewer total numbers to obtain the desired sample size. The result of each number dialed is shown in table 37 for each survey period. The interviewers recorded the results after dialing the number. Recorded messages were the most frequently encountered result of a number produced from the random digit dialing technique. The required sample sizes for the Gunnison surveys were larger than the Rio Blanco sample sizes, so the total number of different numbers dialed was larger.

The information in the tables described above indicate the allocation of the sample sizes to specific prefixes and number banks, the number of phone numbers used in each survey, and the result of dialing each number. Table 38 describes a different look at the data. Since the survey design specified at least three calls to a number before that number was discarded from the sample, the total number of calls attempted to meet the sample size is larger than the total number of telephone numbers used. In table 38, the first Gunnison survey period utilized 483 calls to 330 telephone numbers to contact 90 households that would

Table 37. Results of dialing each telephone number selected (Household survey, summer 1977).

Result	Number of telephone numbers dialed			
	RIO 1	RIO 2	GUN 1	GUN 2
Nonworking	16	2	29	12
Recorded message	88	42	94	112
Non-connection	30	13	0	3
Unanswered rings	50	61	63	80
Non-household	11	20	32	14
Household	76	82	106	112
Busy signal	8	8	3	11
Household (wrong county)	1	0	3	3
Wrong number connected	0	0	0	1
TOTAL	280	228	330	348

Table 38. Breakdown of the total calls made (Household survey, summer 1977).

Breakdown	Number in each category			
	RIO 1	RIO 2	GUN 1	GUN 2
Telephone numbers	280	228	330	348
Telephone calls attempted[a]	362	263	483	419
Interviews	61	75	90	100
Non-response (refusals)	15	7	16	12
Bank closed[b]	58	69	66	91

[a]Many numbers were dialed more than once when the result of the first or second dialing was either unanswered rings or busy signals.

[b]The sample in the bank was completed before these numbers were dialed three times.

participate in the survey. This table also shows the number of households who refused to participate in the survey. The highest percentage of refusals was during the first Rio Blanco survey where almost 20% of the total households reached (interviews + non-response) were refusals. The category labeled "bank closed" refers to those telephone numbers which had not been dialed three times before the required sample size was reached.

The use of the random digit dialing technique to select the sample numbers assured that each member of the population being sampled had an equal opportunity to be selected, but considerable interviewer time was used to dial all the numbers required to obtain the needed sample size. More specific information from the telephone companies describing the working household versus non-working telephone number ratio in each number bank would reduce the number of calls. By excluding the non-working numbers etc. from the sample selected, there would be a higher probability of reaching a household number.

Results of the analysis of the sample data

The recreation participation data collected during the household survey are summarized in this section for each study area. The sample data collected during both survey periods in each study area were combined to provide a description of the recreation participation in each study area during a one month period. The data in this section reflect the recreation participation of only the households interviewed during the survey periods. The data have been organized into tables of recreation activities, where the recreation occurred, and selected characteristics of the recreationists.

Table 39 for Rio Blanco County and table 40 for Gunnison County show the total number of households with recreation participation in a specific activity. Two breakdowns of the activity participation data are in each table. Column 1 presents the total number of households surveyed in which the respondents indicated a member of that household recreated in at least one of the activities listed anywhere in the study area. For example, table 40 shows 62 households in which at least one member from each household recreated by fishing. This represented 43% of all the households that participated in some form of recreation. The percentages listed in column 2 are based on 143 total households that recreated.

In the three right columns of each table the activity data were disaggregated to reflect the activity participation by households only in zones containing BLM land. Two sets of percentages (columns 4 and 5 in each table) were calculated to provide useful data. The fourth column gives the percentage of the total households recreating that recreated in a specific activity in zones containing BLM land. The last column describes, for those households who recreated in zones containing BLM land, the percent that recreated in each activity in those zones. The columns in each table tabulating the percents by activity do not add to 100% since many of the households recreated in more than one activity. The most popular activities in both study areas were fishing and hiking/walking.

The information contained in tables 41 and 42 for Rio Blanco and Gunnison Counties disaggregates the activity data to specific zones in figures 2 and 3. These data are useful in describing the recreation participation in designated areas in each study area. In addition to the raw frequency counts provided for each zone, two sets of percentages

Table 39. Sample recreation participation totals by activity (Rio Blanco County, household survey, summer 1977).

Activity	All zones		Total for zones containing BLM land		
	Number[a]	Percent[b] (n=57)	Number[a]	Percent[b] (n=57)	Percent[c] (n=46)
Boating-lake	2	4	2	4	4
Boating-river	1	2	1	2	2
Camping near auto	13	23	6	11	13
Camping away from auto	1	2	0	0	0
Fishing	30	53	19	33	41
Picnicking	9	16	5	9	11
Sightseeing	4	7	3	5	7
4-wheel driving	7	12	7	12	15
Motorcycling	4	7	4	7	9
Bicycling	3	5	3	5	7
Collecting	6	11	4	7	9
Hiking/walking	19	33	11	19	24
Mountain climbing	0	0	0	0	0
Horseback riding	3	5	3	5	7
Hunting	2	4	2	4	4
Wildlife viewing	2	4	1	2	2
Photography	0	0	0	0	0
Nature study	1	2	1	2	2
Other	8	14	8	14	17
Swimming	3	5	3	5	7
Tennis	1	2	1	2	2
Softball/baseball	3	5	3	5	7

[a]Number of households in which respondent indicated that someone participated in listed activity.

[b]Calculated using total number of recreationists sampled.

[c]Calculated using total number of recreationists sampled using zones containing BLM land.

Table 40. Sample recreation participation totals by activity (Gunnison County, household survey, summer 1977).

Activity	All zones		Total for zones containing BLM land		
	Number[a]	Percent[b] (n=143)	Number[a]	Percent[b] (n=143)	Percent[c] (n=80)
Boating-lake	16	11	13	9	16
Boating-river	3	2	2	1	3
Camping near auto	18	13	4	3	5
Camping away from auto	10	7	2	1	3
Fishing	62	43	35	24	44
Picnicking	27	19	12	8	15
Sightseeing	12	8	5	3	6
4-wheel driving	20	14	8	6	10
Motorcycling	10	7	2	1	3
Bicycling	32	22	24	17	30
Collecting	13	9	3	2	4
Hiking/walking	61	43	16	11	20
Mountain climbing	5	3	1	1	1
Horseback riding	16	11	9	6	11
Hunting	7	5	3	2	4
Wildlife viewing	14	10	3	2	4
Photography	14	10	3	2	4
Nature study	3	2	1	1	1
Other	32	22	28	20	35
Swimming	13	9	9	6	11
Tennis	24	17	17	12	21
Softball/baseball	14	10	8	6	10

[a]Number of households in which respondent indicated that someone participated in listed activity.

[b]Calculated using total number of recreationists sampled.

[c]Calculated using total number of recreationists sampled using zones containing BLM land.

Table 41. Sample recreation participation totals by activity for specific zones (Rio Blanco County, household survey, summer 1977).

ACTIVITY	Zone A			Zone B			Zone C			Zone D			Zone E			Zone F		
	N[a]	Percent[b] (n=57)	Percent[c] (n=16)	N[a]	Percent[b] (n=57)	Percent[c] (n=5)	N[a]	Percent[b] (n=57)	Percent[c] (n=3)	N[a]	Percent[b] (n=57)	Percent[c] (n=16)	N[a]	Percent[b] (n=57)	Percent[c] (n=16)	N[a]	Percent[b] (n=57)	Percent[c] (n=18)
Boating-lake	-			-			-			1	2	6	1	2	6	-		
Boating-river	-			-			-			1	2	6	-			-		
Camping near auto	-			2	4	40	-			-			4	7	25	7	12	39
Camping away from auto	-			-			-			-			-			1	2	6
Fishing	-			1	2	20	1	2	33	5	9	31	13	23	81	14	25	78
Picnicking	1	2	6	1	2	20	-			2	4	13	1	2	6	5	9	28
Sightseeing	2	4	13	-			1	2	33	3	5	19	-			1	2	6
4-wheel driving	2	4	13	3	5	60	-			1	2	6	2	4	13	-		
Motorcycling	2	4	13	1	2	20	-			1	2	6	-			-		
Bicycling	1	2	6	-			-			2	4	13	-			-		
Collecting	2	4	13	1	2	20	-			-			1	2	6	2	4	11
Hiking/walking	6	11	38	1	2	20	-			1	2	6	3	5	19	8	14	44
Mountain climbing	-			-			-			-			-			-		
Horseback riding	-			-			-			-			3	5	19	-		
Hunting	1	2	6	-			-			-			1	2	6	-		
Wildlife viewing	1	2	6	-			1	2	33	1	2	6	-			1	2	6
Photography	-			-			-			-			-			-		
Nature study	-			-			-			-			1	2	6	-		
Other	1	2	6	-			2	4	67	4	7	25	1	2	6	-		
Swimming	-			1	2	20	-			2	4	13	-			-		
Tennis	1	2	6	-			-			-			-			-		
Softball/baseball	2	4	13	-			-			1			-			-		

[a]Number of households in which respondent indicated that someone participated in the listed activity.

[b]Calculated using the total number of recreationists sampled.

[c]Calculated using the total number of recreationists sampled who recreated in the indicated zone.

Table 42. Sample recreation participation totals by activity for specific zones (Gunnison County, household survey, summer 1977).

ACTIVITY	Zone A			Zone B			Zone C			Zone D			Zone E			Zone F			Zone G		
		Percent			Percent			Percent			Percent			Percent			Percent			Percent	
	N[a]	(n=143)[b]	(n=1)[c]	N[a]	(n=143)[b]	(n=19)[c]	N[a]	(n=143)[b]	(n=61)[c]	N[a]	(n=143)[b]	(n=11)[c]	N[a]	(n=143)[b]	(n=22)[c]	N[a]	(n=143)[b]	(n=58)[c]	N[a]	(n=143)[b]	(n=33)[c]
Boating-lake	-			1	1	5	12	8	20	-			-			2	1	3	1	1	3
Boating-river	-			-			2	1	3	-			-			1	1	2	1	1	3
Camping near auto	1	1	100	1	1	5	2	1	3	-			5	3	23	3	2	5	2	1	6
Camping away from auto	-			1	1	5	1	1	2	-			2	1	9	5	3	9	3	2	9
Fishing	1	1	100	8	6	42	26	18	43	2	1	18	5	3	23	21	15	36	11	8	33
Picnicking	-			4	3	21	7	5	11	1	1	9	3	2	14	9	6	16	6	4	18
Sightseeing	-			1	1	5	2	1	3	2	1	18	4	3	18	3	2	5	5	3	15
4-wheel driving	-			3	2	16	3	2	5	2	1	18	5	3	23	6	4	10	6	4	18
Motorcycling	-			2	1	11	-			-			-			4	3	7	6	4	18
Bicycling	-			1	1	5	21	15	34	2	1	18	-			9	6	16	1	1	3
Collecting	-			1	1	5	1	1	2	1	1	9	3	2	14	5	3	9	3	2	9
Hiking/walking	1	1	100	5	3	26	10	7	16	2	1	18	9	6	41	31	22	53	13	9	39
Mountain climbing	-			-			-			1	1	9	-			1	1	2	4	3	12
Horseback riding	-			2	1	11	6	4	10	1	1	9	1	1	5	6	4	10	-		
Hunting	-			2	1	11	-			1	1	9	1	1	5	2	1	3	1	1	3
Wildlife viewing	-			1	1	5	1	1	2	1	1	9	2	1	9	5	3	9	5	3	15
Photography	-			-			1	1	2	2	1	18	2	1	9	7	5	12	5	3	15
Nature study	-			-			1	1	2	-			1	1	5	1	1	2	-		
Other	-			2	1	11	27	19	44	1	1	9	1	1	5	9	6	16	1	1	3
Swimming	-			1	1	5	8	6	13	-			-			4	3	7	-		
Tennis	-			1	1	5	17	12	28	1	1	9	-			7	5	12	-		
Softball/baseball	-			-			8	6	13	-			-			6	4	10	-		

[a]Number of households in which respondent indicated that someone participated in the listed activity.

[b]Percent calculated using the total number of recreationists sampled.

[c]Percent calculated using the total number of recreationists sampled who recreated in the indicated zone.

are given to describe the use of each zone. The first is based on the total number of households recreating anywhere in the county, while the second is a function of only those households that recreated in the designated zone. In Gunnison County (table 42), zone C had the highest level of recreation participation. This can be attributed to the city of Gunnison (the major population center in the County) and to the recreation opportunities provided for fishing, boating, picnicking, etc. by Blue Mesa Reservoir. Zones E, F, and G also exhibit high participation rates. These zones contain all the national forest land in the County which provide a variety of opportunities for recreation.

The remaining tables described in this section (tables 43-46) describe the recreationists from the households participating in recreation in each study area. Thirty-five percent of the households recreating in Rio Blanco County recreated in groups of two people (table 43). Table 43 also shows by categories the person interviewed in each household. The equal status category was designed for respondents who live in a household with roomates where the traditional family setting was not applicable. The same information is presented in table 44 for the Gunnison survey data. The sex and age breakdown of all the recreationists sampled are given in tables 45 and 46 for each study area. Males and females in the 21-45 age bracket are the age group with the highest recreation participation in both study areas.

Estimates of Total Recreation Use

The sample data analysis presented in the preceding section summarized the recreation participation in each study area by delineating the locations and types of recreation activities taking place. This

Table 43. Miscellaneous question totals (Rio Blanco County, household survey, summer 1977).

Question	All respondents		Respondents recreating in zones containing BLM land	
Number of people recreating from surveyed household	Number[a]	Percent[b] (n=57)	Number[a]	Percent[c] (n=45)
1	9	16	6	13
2	20	35	15	33
3	7	12	7	16
4	12	21	12	27
5	7	12	5	11
6	1	2	-	-
7	1	2	-	-
Person interviewed	Number[a]	Percent[b] (n=135)	Number[a]	Percent[c] (n=45)
Father	28	21	9	20
Mother	61	45	20	44
Dependent	10	7	6	13
Equal status	36	27	10	22

[a]Number of households in which respondent indicated specified answer.

[b]Calculated using the total number of respondents answering the question.

[c]Calculated using the total number of respondents answering the question who recreated in zones containing BLM land.

Table 44. Miscellaneous question totals (Gunnison County, household survey, summer 1977).

Question	All respondents		Respondents recreating in zones containing BLM land	
Entered specified wilderness or primitive area	Number[a]	Percent[b] (n=190)	Number[a]	Percent[c] (n=80)
Powderhorn primitive area	6	3	6	8
West Elk wilderness area	4	2	2	3
Did not visit either area	180	95	72	89
Number of people recreating from surveyed household	Number[a]	Percent[b] (n=143)	Number[a]	Percent[c] (n=80)
1	42	29	23	29
2	45	32	25	31
3	20	14	12	15
4	25	17	15	19
5	9	6	5	6
7	1	1	-	-
10	1	1	-	-
Person interviewed	Number[a]	Percent[b] (n=190)	Number[a]	Percent[c] (n=80)
Father	28	15	14	18
Mother	55	29	22	28
Dependent	13	7	9	11
Equal status	94	49	35	43

[a]Number of households in which respondent indicated specified answer.

[b]Calculated using the total number of respondents answering the question.

[c]Calculated using the total number of respondents answering the question who recreated in zones containing BLM land.

Table 45. Sex/Age breakdown of recreationists (Rio Blanco County, household survey, summer 1977).

Sex/Age	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=150)	Number[a]	Percent[c] (n=121)
Male < 15	30	20	24	20
Female < 15	25	17	17	14
Male 16-20	5	3	5	4
Female 16-20	6	4	5	4
Male 21-45	33	22	29	24
Female 21-45	28	19	24	20
Male > 45	12	8	10	8
Female > 45	11	7	7	6

[a]Number includes all the people in the interviewed household who participated in recreation.

[b]Calculated using the total number of people whose ages and sex were given.

[c]Calculated using the total number of people whose ages and sex were given who recreated in zones containing BLM land.

Table 46. Sex/Age breakdown of recreationists (Gunnison County, household survey, summer 1977).

Sex/Age	All respondents		Respondents recreating in zones containing BLM land	
	Number[a]	Percent[b] (n=357)	Number[a]	Percent[c] (n=218)
Male < 15	48	14	31	14
Female < 15	39	11	26	12
Male 16-20	20	6	14	6
Female 16-20	25	7	15	7
Male 21-45	91	25	51	24
Female 21-45	90	25	51	24
Male > 45	25	7	16	7
Female > 45	19	5	14	6

[a]Number includes all the people in the interviewed household who participated in recreation.

[b]Calculated using the total number of people whose ages and sex were given.

[c]Calculated using the total number of people whose ages and sex were given who recreated in zones containing BLM land.

information is useful for pinpointing the areas of low and high recreation participation, but does not describe the total amount of recreation occurring and the degree of variability of the recreation participation. This section presents the estimates of total recreation participation for all the households in each study area across the summer sampling period. Using those procedures previously outlined and the variable total recreation participation per household sampled, the following calculations include: (1) the sample mean number of hours of total recreation per household for each survey period; (2) the estimated population mean number of hours of total recreation per household; and (3) the estimated total hours of recreation for all households across the sampling period. In addition to these estimates, the associated variances show the level of precision and confidence of the recreation use estimates.

Table 47 shows the results of the calculations of the sample mean values for both survey periods in each study area. These values were calculated (equations 2.18 and 2.19) along with the associated variances for each survey period. The sample mean values for Gunnison are twice as large as the comparable statistics for Rio Blanco County. This information also supports the selection of Gunnison County as an area with high levels of recreation use compared to Rio Blanco County. It is interesting to note that the mean values for the sample data from both Gunnison surveys are almost exactly the same, but the variance for the first survey period is one-half as large as the variance for the second survey period. A larger variance from the sample mean resulted from the fact that recreationists sampled during the second survey period were more diversified with respect to how long they recreated.

Table 47. Sample means and variances for each survey in both study areas (Household survey, summer 1977).

County	Survey[a]	Mean[b]	Variance[c]
Rio Blanco	1	25.770	2,921.18
Rio Blanco	2	16.107	1,036.043
Gunnison	1	50.767	6,258.675
Gunnison	2	50.210	12,256.067

[a]Survey 1 sampled recreation participation between July 18 and July 31. Survey 2 sampled recreation participation between August 23 and September 5.

[b]Mean number of hours of total recreation per household during that survey period.

[c]Variance for the mean.

Incorporating the sample mean values from table 47 into equation 2.20, the estimated population mean value was calculated for each study area. This figure describes the expected mean value of recreation participation for any household in the study area for any two-week period during the summer sampling period. Table 48 lists the values for the estimated means and variances.

An estimate of the total amount of recreation occurring from residents of each study area for the whole summer is given in table 49. The population mean estimates shown in table 48 were multiplied by the number of two-week clusters in the summer and the number of households in each study area to calculate the total recreation use. This procedure is outlined in equation 2.22 on page 64. A comparison of the total recreation statistics for each County indicates that Gunnison supports 4.5 times more hours of total recreation from County residents than Rio Blanco County. The estimates are presented in both hours and visitor days. The last column in table 49 presents the variances calculated from equation 2.23 for each total estimate.

The variance estimates shown in tables 47-49 provide the basis for determining the precision of the mean and total estimates. Incorporating the mean and variance estimates in this section with the normal deviate figures at the .1 and .2 alpha levels of confidence, the level of precision of the estimates was calculated using equation 2.10. The results of these calculations are shown in table 50. The information in any row can be interpreted in the following manner. In row 1, there is a 90% probability (i.e. 1 - α level of confidence) that repeated samples of 136 interviews using the same household survey technique employed by this study would provide a mean estimate of the recreation participation

Table 48. Population mean and variance estimates for both study areas (Household survey, summer 1977).

County	Units[a]	Mean[b]	Variance[c]
Rio Blanco	hours	20.94	20.21
Rio Blanco	visitor days	1.745	.140
Gunnison	hours	50.49	16.9
Gunnison	visitor days	4.21	.117

[a] 1 visitor day equals 12 hours.

[b] Population mean estimate.

[c] Variance for the mean estimate.

Table 49. Total summer recreation participation estimates (Household survey, summer 1977).

County	Units[a]	Total[b]	Variance[c]
Rio Blanco	hours	169,069	1.31744×10^9
Rio Blanco	visitor days	14,089	9.14887×10^6
Gunnison	hours	754,219	3.77031×10^9
Gunnison	visitor days	62,852	2.61827×10^7

[a]One visitor day equals 12 hours.

[b]Estimate of the total recreation participation in each study area by in-county residents across the whole summer.

[c]Variance for the mean estimate.

Table 50. Levels of precision and confidence intervals for the estimates produced from the household survey data (Household survey, summer 1977).

County	α levels	Sample sizes (interviews)	Precision levels[a]	Mean[b]	Variance[b]	Confidence limits for the mean[c]
Rio Blanco	.1	136	$\pm$35	1.745	.14	(1.13; 2.36)
Rio Blanco	.2	136	$\pm$27	1.745	.14	(1.26; 2.23)
Gunnison	.1	190	$\pm$13	4.21	.12	(3.64; 4.77)
Gunnison	.2	190	$\pm$10	4.21	.12	(3.77; 4.65)

[a]Defines the deviation in percent of the mean estimate (above and below the estimate).

[b]All values calculated in visitor days.

[c]Delineates the limits of the confidence intervals in units of the mean (above and below the mean).

within the limits of the values defined as ±35% of the 1.745 mean value. The limits are calculated in units of the mean and delineated under the heading confidence limits for the mean. At the same alpha level (.1), the estimates determined from the Gunnison sample data are more precise than the Rio Blanco County estimates (±13% versus ±35% of the mean values). To increase the precision of the estimates produced from the Rio Blanco data, a larger sample size should be selected to decrease the sample mean variances and subsequently reduce the deviations around the population mean estimate.

Sample Size Determinations

This section presents the results of the procedure to determine the sample size estimates at different precision levels calculated from the household survey data. These sample sizes will be compared to the sample size estimates produced from the roadside survey. Therefore, as outlined in the methodology chapter, the sample size estimates should be developed from estimates of recreation participation that are consistent between the roadside and household surveys. The recreation participation estimates from the household survey data in tables 47-49 from the household survey data were based on total recreation participation by households during a two-week period. The roadside survey data represent only the recreation participation from a single trip to the study area. To maintain consistency between the surveys the household data were reanalyzed to adjust the recreation participation to reflect the amount of time spent on one trip during the two-week period by each household. Tables 55 and 56 in appendix D present the values for the sample adjusted means and variances and the figures reflecting the

adjusted population mean and variance estimates. These estimates were not developed to describe the recreation participation, but to facilitate the analysis of the sample sizes presented in this section.

Sample sizes for different levels of precision

Desired sample sizes were calculated by using the adjusted population mean and variance estimates given in appendix D as the primary inputs to equation 24 and by incorporating the specific precision and confidence levels into the calculations. Sample sizes were calculated for predetermined precision levels (±50%, ±25%, and ±10% of the mean estimate) and alpha levels of confidence (.1 and .2) to illustrate how the sample sizes would vary if estimates of recreation use were desired at different levels of precision.

The results of these calculations for Rio Blanco and Gunnison Counties are shown in tables 51 and 52. The actual sample sizes of the household survey conducted for this research along with the associated precision levels are given in the first two lines of each table at the .1 and .2 alpha levels of confidence. The other estimates listed in rows 3 thru 8 specify the calculated sample sizes at the different precision and alpha levels. Referring to the methodology outlining the sample size estimating procedure on page 68, the equation adopted for the calculations required that two variables be solved using one equation. This procedure produced an infinite number of solutions. Therefore, one of the variables (number of clusters to sample) was fixed at various feasible levels, while the other variable (sample size per cluster) was allowed to vary. This process produced a series of sample sizes corresponding to the selected cluster sizes for each precision and confidence

Table 51. Estimated sample sizes and confidence limits for different levels of precision and confidence (Rio Blanco County, household survey, summer 1977).

α levels	Precision levels[a]	Sample size per cluster	Number of clusters	Total sample size[b]	Mean[c]	Variance[c]	Confidence limits for the mean[d]
.1	±19[e]	68	2	136	.893	.011	(.72; 1.07)
.2	±15[e]	68	2	136	.893	.011	(.76; 1.03)
.1	±50	8	1	8	.893	.074	(.45; 1.34)
.2	±50	5	1	5	.893	.121	(.45; 1.34)
.1	±25	54	1	54	.893	.0185	(.67; 1.12)
.2	±25	25	1	25	.893	.030	(.67; 1.12)
.1	±10	211	4	846	.893	.003	(.80; .98)
.2	±10	147	3	442	.893	.005	(.80; .98)

[a]Defines the deviation in percent of the mean estimate (above and below the estimate).

[b]Optimum total sample sizes determined by multiplying the number of clusters by the sample size per cluster.

[c]All values are calculated in visitor days.

[d]Delienates the limits of confidence intervals in units of the mean (above and below the mean).

[e]Actual estimated precision levels for the sample data estimates from the summer surveys at the .1 and .2 alpha levels.

Table 52. Estimated sample sizes and confidence limits for different levels of precision and confidence (Gunnison County, household survey, summer 1977).

α levels	Precision levels[a]	Sample size per cluster	Number of clusters	Total sample size[b]	Mean[c]	Variance[c]	Confidence limits for the mean[d]
.1	±16[e]	95	2	190	2.25	.045	(1.9; 2.6)
.2	±12[e]	95	2	190	2.25	.045	(1.98; 2.52)
.1	±50	6	1	6	2.25	.468	(1.13; 3.38)
.2	±50	3	1	3	2.25	.771	(1.13; 3.88)
.1	±25	36	1	36	2.25	.117	(1.69; 2.8)
.2	±25	17	1	17	2.25	.193	(1.69; 2.8)
.1	±10	158	4	631	2.25	.019	(2.03; 2.48)
.2	±10	109	3	326	2.25	.031	(2.03; 2.48)

[a]Defines the deviation in percent of the mean estimate (above and below the estimate).

[b]Optimum total sample sizes determined by multiplying the number of clusters by the sample size per cluster.

[c]All values are calculated in visitor days.

[d]Delineates the limits of the confidence intervals in units of the mean (above and below the mean).

[e]Actual estimated precision levels for the sample data estimates from the summer surveys at the .1 and .2 alpha levels.

level. The optimum sample size at each level was selected from the feasible solutions based on the solution which required the fewest number of total interviews while still maintaining the desired precision and confidence. In column 4 of each table, the recommended number of clusters to sample is presented for each precision and alpha level. The total sample size was calculated by multiplying the sample size per cluster (column 3) by the number of clusters recommended for sampling. The total sample size values represent the specific sampling levels required to obtain sample data from repeated household surveys where the mean estimates of recreation participation are expected to fall within the established units of the mean (precision) a certain percentage of the time ($1 - \alpha$ level of confidence).

Data Limitations

Previous sections in this chapter present the results of the sample recreation data and the sample size analysis for the household survey component of the research. This section describes the data limitations associated with the results describing the recreation participation calculated from the sample data, and outlines some of the problems encountered with the survey technique.

Most of the major limitations of the household survey data are reflected in the interpretation of the sample data results. These limitations are similar to those encountered in the roadside data analysis. The sample data for the household survey were presented as frequency counts and percentages of recreation use based on the individual household as the primary unit of analysis. The frequency outputs would have presented more information if the analysis had calculated the recreation

use on the basis of an individual user, but the sampling structure was based on a random sample of households, not individuals. Therefore, to avoid violating the sampling design or misrepresenting the results, all the sample data and mean estimates were structured on a household basis.

The information for the household survey was presented in the same framework as the roadside survey analysis. The recreation participation data limited the applicability of the analysis by not pinpointing site-specific recreation information. To present information describing recreation use at specific sites, the size of the sample would have to be increased and the questionnaire extended. This would lengthen the time spent for each interview and increase the cost of acquiring the sample data.

Information gathered during the telephone interview provided one limitation with the survey technique. The respondent was asked to recall the recreation participation of all household members during a two-week period. While the activity information was considered accurate, it is not known how well a respondent can estimate the total time spent recreating by the household members. Twenty-five of the households were recalled by the project supervisor to determine: (1) how the respondent felt about the telephone survey; (2) how well the interviewer conducted the interview; and (3) the accuracy of the information provided. The general response to these questions was positive. While there are no quantitative data specifying the precision of the information provided during the interview, the information from the households recalled indicates that the interview progressed smoothly and the questions were easily understood by the respondents.

The estimates of total use calculated in this chapter provide a description of the total amount of recreation participation (in hours and visitor days) occurring in each study area during the summer sampling period as well as the mean, total, and variance estimates necessary for the calculation of the sample size estimate. As in the roadside survey, the household survey total use estimating procedure incorporated a zero value for those respondents who indicated no hours of recreation participation. Consequently, the mean estimates of recreation participation per household were lower than the estimates would have been if only the recreationists had been included in the analysis. By maintaining a consistent analysis technique between the roadside and household surveys, the sample size comparison in the next section is more meaningful.

Sample Size Comparison

Objective 2 required that this study produce statewide sample size estimates for future SCORP demand surveys designed to produce recreation participation information useful to the BLM. Two sample survey techniques were used to meet objective 2 in each of two study areas. Previous sections in this chapter have presented the sample size estimates for each survey technique in both study areas. The result is four separate analyses specifying sample size estimates at designated levels of precision and confidence. The remainder of this chapter presents the relationship between the estimated sample sizes produced in each analysis and delineates the procedure for ascertaining one statewide sample size. Included in this section are: (1) a comparison between the estimated sample sizes using each survey technique (i.e., roadside and household surveys); (2) a discussion of the relationship between the estimates

for each study area; (3) a procedure for determining statewide sample sizes for future SCORP demand surveys at specified precision and confidence levels using the estimates developed in this study; and (4) a discussion of the limitations of the results of this pilot study.

Comparison of Sample Sizes Produced from Each Survey

The data from the roadside and household surveys were analyzed to produce sample size estimates at specified precision and confidence levels. A comparison of these estimates provides a way to discuss the adequacy of the methodology in this pilot study to determine estimates of statewide sample sizes. For a meaningful comparison the sample size estimates from both survey techniques must: (1) be developed from recreation participation estimates defining recreation in a consistent manner, and (2) reflect the recreation participation from the same population of households. The first requirement specifying a consistent definition of recreation participation was met by collecting the recreation participation data from the respondents in each survey based on an identical recreation time frame (i.e., per recreation trip) and by analyzing those data in common units (i.e., hours and visitor days). Briefly, the second requirement was to structure two sets of sample size estimates developed from surveys measuring different components of recreation participation (inter-county versus in-county recreation participation), so that the final sample sizes from both survey techniques reflected the recreation participation from the same population of households. The procedure developed to satisfy this requisite was described on page 70. The roadside survey results were used to solve for the sample sizes necessary to sample recreation participation of

in-county residents in Gunnison and Rio Blanco Counties.[13] This information is comparable to the household survey estimates calculated earlier.

Table 53 presents the final sample size estimates from the analysis of the data from each survey technique. These estimates represent the sample sizes that would be needed to sample in-county recreation participation in each study area at the desired precision and confidence levels. The estimated sample sizes from each survey are shown adjacent to each other by study area to facilitate a visual comparison. The first two rows of the table show the actual precision (at the .1 and .2 alpha levels of confidence) of the sample data collected during the summer surveys using the designated sample sizes.[14] The important information from these sample sizes is that more precise recreation participation data were collected during the household survey than the roadside survey across both study areas. This is shown by the smaller precision level percentages in the household survey columns.

The remaining rows (3-8) in table 53 show the estimated sample sizes for each survey that would be needed if recreation participation estimates were desired at the specified precision and confidence levels.

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[13]While the roadside survey did not sample recreation participation from the residents of the two study areas, the propensities of households from adjacent counties to visit the study areas and the population of households in each study area was extrapolated to solve for estimates of the sample sizes necessary to sample recreation participation in each study area at the desired precision and confidence levels. Incorporating the propensity values from the counties adjacent to the study area could create sample size estimates slightly higher than needed. But, this method reduced the risk of creating sample sizes too small.

[14]The roadside survey did not sample recreation participation of the residents in either study area county. The sample sizes were determined using the procedure described on page 71 in the preceding chapter and reiterated in the last paragraph. These represent the sampling levels that would have been realized if the roadside survey had been implemented in those counties at the confidence and precision levels realized by the roadside survey.

Table 53. Sample size comparison (Roadside and household surveys, summer 1977).

α levels	Precision levels[a]	Rio Blanco sample sizes		Gunnison sample sizes	
		Roadside	Household	Roadside	Household
.1	sample data	(±57%)[b] 16	(±19%)[b] 136	(±28%)[b] 21	(±15%)[b] 190
.2	sample data	(+44%)[b] 16	(±15%)[b] 136	(±21%)[b] 21	(±12%)[b] 190
.1	±50	20	8	7	6
.2	±50	13	5	4	3
.1	±25	62	54	24	36
.2	±25	42	25	15	17
.1	±10	-[c]	846	158	631
.2	±10	137	442	92	326

[a]Defines the deviation on either side (above and below) of the mean and total estimates.

[b]Actual estimated precision levels for the sample data at different α levels for the data collected during the summer survey.

[c]A sample size would not be estimated at this level using the survey design and procedures used for the roadside survey (i.e., sample size needed is too large to obtain).

A consistent trend is evident. The household sample sizes are smaller for low levels of precision (high percentages) and larger for high levels of precision (small percentages) than the roadside estimates at the same levels of precision and confidence. For example, in Rio Blanco County the predicted household sample sizes are smaller at the ±50% precision levels than comparable roadside estimates. At the ±25% levels the household sample sizes are still smaller, but the magnitude of the difference is less. Then for the ±10% levels, the household samples jump past the roadside sample sizes. The same pattern is illustrated in the sample size estimates calculated for Gunnison County, except that the household estimates surpass the roadside estimates at the ±25% levels.

The household sample sizes shown at the ±10% precision levels are significantly higher than the roadside estimates at the same levels. This discrepancy is a function of two factors which combine to influence the calculation of the sample sizes, including: (1) the principal or largest component of variance is different for each survey, and (2) the total population of clusters in the household survey is very small (i.e., 5.5 clusters). The first item focuses on the within and between components of variance used to calculate the total variance for the total use estimates produced from each survey. The major component of variance in the roadside survey estimates was the between component. The variance between the clusters was larger than the variance within the cluster. The household survey was exactly opposite. The two clusters sampled had nearly identical means, while the variation in each individual cluster was large. Therefore, the within component of variance was large and the between component small. When solving for sample sizes at successively higher levels of precision, the overall variance component must be

reduced. The roadside survey increased the number of clusters sampled to reduce the variance, while the household survey increased the sample size in each cluster. This difference by itself would not create the discrepancies noted in table 53.

The second reason for this discrepancy indicated that the total population of clusters in the household survey analysis was 5.5. This figure is used during the calculations of both components of variance. By increasing the number of clusters sampled from one cluster to two clusters to three clusters, etc., the ratio of the number of clusters sampled (n) to the total population of clusters (N) increases by a factor of approximately 20% for each cluster jump. As part of the finite population correction factor (1-(n/N)), this ratio value forces the between component of variance to zero. The between component of variance in the household estimates is already very small and the contribution to the reduction of total variance is negligible, but the ratio (n/N) is also used during the calculation of the within component of variance. An increase in the number of clusters sampled causes the ratio to increase and subsequently raises the contribution of the within component of variance. Since the primary goal during the sample size analysis was to decrease the overall variance, a small total population of clusters would hinder the process of achieving reduced variances and high precision levels. Combining the large within component contribution to variance with the ratio effect described above, the household survey sample sizes in each cluster were forced higher and higher until the desired precision level could be attained.

The roadside survey sample sizes increased at a more constant rate. A sample size limit was reached during the roadside analysis in Rio

Blanco County at the ±10% precision level with an alpha level of confidence of .1. This precision level could not be attained without increasing the number of interview stations or the number of samples collected at each station. The process of approaching the limit did not create the jump realized in the household survey analysis.

The previous discussion indicates that the analyses used to calculate sample sizes for each survey develops limits at high precision levels. As the constraints of the survey design are approached, each necessary incremental decrease in variance becomes harder to achieve. The problem may not be associated with the analysis techniques, but with the large variability in recreation participation between users sampled during the summer surveys. The variation may be so high that a specific level of precision cannot be reached using these analytical techniques or similar techniques. Aside from the discrepancies between the sample sizes at high precision levels below the ±10% levels, the roadside survey analysis appears to give reasonable estimates of the sample sizes required at precision levels less accurate than ±10% in the study area Counties. Therefore, it is assumed that the sample size estimates produced from the roadside survey are reasonable estimates of the sampling levels needed to sample recreation participation at the specified precision and confidence levels.

Sample Size Estimates for Each Study Area

There were two study areas for the roadside and household surveys during the summer season. Two study areas were needed to provide statewide sample size estimates which would delineate the maximum and minimum levels necessary for sampling recreation participation in all counties

containing BLM Public Land in the State. Gunnison and Rio Blanco Counties were selected on recommendations by the BLM indicating that these two Counties exhibited the extremes (maximum and minimum) of variability associated with the dispersed recreation opportunities available and in levels of dispersed recreation participation on Public Land in the State. The sample size estimates for each study area reflect the differences in recreation opportunities and participation between the Counties.

Table 54 shows the statewide sample size estimates needed for a household telephone survey designed to collect recreation participation estimates at the specified precision and confidence levels for each study area. These figures were calculated by summing the appropriate values at each precision and confidence level from tables 26, 27, and 53. Tables 26 and 27 show the estimated statewide sample sizes across all Colorado counties exluding the study areas, while table 53 presents the sample sizes for each study area. Therefore, the information in table 54 represents the total estimated sample sizes for a statewide household telephone survey calculated from roadside survey data. The first two rows in the table show the number of telephone calls necessary to acquire the sample sizes equivalent to the sample sizes collected during the roadside survey. The remaining rows show the estimated sample sizes for each study area at the designated precision and confidence levels. The sample sizes calculated for Gunnison County are significantly smaller than those shown for Rio Blanco County. Since more households in Colorado are inclined to visit Gunnison County (refer to propensities in tables 26 and 27), fewer telephone calls are needed to contact households that visited Gunnison County. Therefore, the number of interviews required to calculate recreation participation estimates at the specified

Table 54. Estimated statewide sample needed for a household telephone survey (Roadside survey, summer 1977).

α level	Rio Blanco County		Gunnison County	
	Precision level	Number of completed calls needed[a]	Precision level	Number of completed calls needed[a]
.1	±57%	7,296[b]	±28%	2,042[b]
.2	±44%	7,296[b]	±21%	2,042[b]
.1	±50%	9,199	±50%	785
.2	±50%	5,753	±50%	506
.1	±25%	29,057	±25%	2,644
.2	±25%	19,698	±25%	1,627
.1	±10%	-[c]	±10%	15,656
.2	±10%	64,462	±10%	9,060

[a]Statewide sample size needed for a household telephone survey to collect recreation participation data at the specified precision and confidence levels.

[b]Number of calls necessary to acquire the sample size surveyed in the roadside destination survey (summer 1977).

[c]A sample size could not be estimated at this level using the survey design and procedures used for the roadside survey (i.e., sample size needed, too large to obtain).

levels of precision and confidence will be reached faster for Gunnison County than for Rio Blanco County. This supports the selection of Gunnison County as an area of high recreation participation and extensive recreation opportunities relative to Rio Blanco County.

The data in table 54 define the maximum and minimum sample size estimates which would be needed to sample recreation participation in any Colorado county containing significant amounts of BLM Public Land. By ascertaining the degree of similarity of dispersed recreation opportunities and dispersed recreation participation between the sampled counties and all other counties in Colorado containing Public Land, the estimates of statewide sample sizes for future SCORP surveys providing recreation participation data for counties containing BLM lands can be determined by adjusting the estimated sample sizes between the maximum and minimum levels provided in table 54.

Statewide Sample Size for Future Surveys

The previous two sections in this chapter compare the sample size estimates calculated from the recreation participation estimates from each survey technique and describe the relationship between the two study areas. Conclusions from the comparison in the first section indicate that the roadside survey sample size estimates provide an adequate estimate of the statewide sample sizes needed for a household telephone survey. The second section explores the relationship between the sample sizes calculated for each study area and describes how this information can be used to estimate a statewide sample size designed to produce recreation participation data useful to the BLM in counties containing Public Land.

This section outlines the procedure for combining the information from the previous two sections to develop one statewide sample size estimate. Since the intention of this study was not to define the recreation data needs of the BLM, which may vary by location and over time, an actual statewide sample size estimate will not be calculated. Rather, a description will specify the procedure to use the information from the analyses to develop a statewide sample size estimate. This will provide the BLM the latitude to adjust the sample sizes to meet their planning needs at the time the survey is implemented. The discussion will focus on the decisions the BLM must make to develop the sample sizes. These decisions include: (1) the identification of the levels of precision and confidence of the total recreation participation estimates produced from a statewide survey, and (2) the use of the maximum and minimum sample size estimates determined in this pilot study to ascertain one sample size level which would best provide the recreation participation estimates describing the important recreation use on all BLM lands in the State.

The first item requires the BLM to make an objective decision specifying how accurate the recreation participation estimates need to be. The critical decision weighs the importance of collecting recreation participation information at different accuracy levels versus the cost of acquiring that information. Factors which influence the decision include: (1) what the information will be used for (activity planning, Management Framework Plans, funding justification), and (2) how often the data will be needed. The different levels of precision and confidence utilized by this research to present the sample size estimates aid this decision process. The estimates at each precision level specify

the range of the expected true population value. As the need for greater accuracy increases, the precision level range narrows, the sample sizes increase, and the cost of acquiring the data goes up. The alpha levels of confidence define the probability that the recreation participation estimates will fall into the ranges defined at each precision level. When the purpose of the recreation participation information is determined, sample sizes can be selected at the precision and confidence levels which satisfy the agency's needs. One way to structure the decision process would be to weigh the cost of making a wrong decision based on bad data, versus the cost of acquiring sample data that would facilitate a correct decision.

The second decision relates to the sample size estimates determined for each study area presented in the last section. The sample size estimates for both study areas represent the maximum and minimum sampling levels necessary to acquire data describing recreation participation estimates for any Colorado county containing significant amounts of BLM land. To determine one statewide sample size level the BLM must decide what sampling level between the two extremes provided would best furnish the recreation participation data. This requires that the similarity between the recreation opportunities provided and recreation participation expected in all Colorado counties containing BLM lands and the two study areas be determined. If most of the BLM land exhibits characteristics similar to the Rio Blanco setting, sample size estimates close to the maximum levels should be selected. Although most of the recreation opportunities and use characteristics associated with the Public Land may be similar to Rio Blanco County, the recreation participation information may only be desired for the high use areas. Therefore, the cost

of acquiring data describing all the recreation participation may be too high, and sample sizes closer to the Gunnison levels should be selected. The maximum and minimum levels calculated during this study should be considered the endpoints for each extreme designating the range of feasible sample sizes.

The decisions outlined above require BLM managers and resource planners in Colorado to indicate their specific needs for recreation participation data. Once the decisions are made, the information provided in this document can be used to structure the statewide sample sizes at the appropriate levels.

Limitations of the Interpretation of the Sample Size Estimates

The last section discussed the procedure for determining one statewide sample size estimate designed to sample recreation in all counties containing BLM land in Colorado using a household telephone survey technique. During the analysis of the sample size estimates for each survey technique, certain factors affecting the magnitude of the estimates were identified as important, because they influenced the interpretation and application of the final estimates. The following items separate the factors into specific problem areas: (1) the roadside survey analysis procedure assumed that a household only visited the study areas once during the summer season; (2) the recreation participation information collected during the roadside sampling may describe recreation participation differently than data acquired from a household telephone survey; (3) the sample size estimates for this survey included only the in-state component of recreation participation; (4) sample size estimates allocated

at the state level may not produce the expected recreation participation estimates; and (5) the sample size estimates for this pilot study were not designed to produce recreation participation estimates by activities or in areas of the State smaller than counties. These considerations are explained in the following paragraphs.

The sample data collected during the roadside survey were obtained by interviewing the household members in vehicles exiting the study area. To facilitate the determination of the sample sizes from the roadside data, each household sampled was assumed to visit the study area once during the summer season. This assumption enabled the calculation of the propensity of a household in an origin county to visit one of the study areas. While the assumption may be accurate for counties not adjacent to the study areas, the counties in the immediate vicinity of the study area would contain households that had multiple visits to the study areas. In some instances, adjacent counties to the study areas had a propensity of (1/1) to visit that study area. This implied that every household in that county visited the study area. The effect of this discrepancy on the sample size estimates may be to underestimate the number of calls necessary to reach a household that visited the area from adjacent counties. Therefore, the overall sample size estimates may be too small.

The recreation activity most often mentioned in each study area during the roadside survey sampling was sightseeing, while the household data revealed fishing. Over 55% of the roadside respondents, who engaged in recreation in either study area, indicated sightseeing as one of their recreation activities. The household survey respondents participating in recreation identified sightseeing as a recreation activity less than 13%

of the time. There are two possible explanations for this discrepancy: (1) the sampling correctly indicated that people living outside the study areas recreated in different activities than the people living inside the study areas, and (2) the two survey techniques sampled recreation participation in different settings and created a different respondent orientation to the recreation participation questions. There are no data that indicate which explanation has the greatest influence, but it appears that the first explanation might not account for the whole discrepancy. The second explanation indicates that the sampling methodology adopted by each survey technique may sample recreation participation in a different manner. In the roadside survey the respondent is in a vehicle and might be more inclined to indicate recreation participation in sightseeing. This might be especially true if the study area county was not the major trip destination, and the respondent was just passing through. The household survey, sampling the respondents during a phone conversation, asked them to recall the recreation participation of the whole household during a two-week period. The respondent may have been oriented toward the participation in recreation activities at the trip destination and not during the trip to and from the area. If this is the case, a household survey in an origin county may not collect reliable travel information from households recreating in specific destination counties across the State. The implication of this discrepancy to the sample size estimates is not known. Since it appears that the two survey techniques acquire different types of recreation participation information, the sample sizes determined from the roadside sample data may not accurately predict the actual sample sizes needed for a household telephone survey.

The third factor influencing the interpretation and application of the results is the scope of the research. Although both the in-state and out-of-state components of recreation participation were sampled during the study, the sample size estimates were based on only the in-state data. Sampling out-of-state recreation participation was not investigated in this study because the primary emphasis was on developing sample sizes for future SCORP surveys to sample in-state recreation participation. Out-of-state recreationists represent a major component of the recreation participation in Colorado. Table 4 indicated that 45% of the vehicles stopped in Rio Blanco County were from out-of-state locations. Fifty-seven percent of the Gunnison roadside respondents were from out-of-state. They accounted for 65% of the interviews of respondents who recreated in Gunnison County. These figures indicate that a comprehensive study designating sample sizes for future surveys should include the out-of-state component of recreation participation.

The most important factor influencing the application of the results of this study is that the procedure for determining a sample size for a future SCORP survey does not include regional propensity discrepancies. A telephone survey conducted at the state level would select randomly a sample of households to be included in the sample. Since a large portion of the State's population lives along the front range between Pueblo and Ft. Collins, a high proportion of the interviews would be selected from that area. Further analysis of the roadside data indicated that the propensity of a household to visit the specified study area from the front range was considerably less than the propensity calculated for a household residing in counties near the study area. For this reason the roadside sample size estimates presented on page 114 in this chapter were

calculated by origin region in Colorado to illustrate the regional differences. Analysis of the distribution of interviews collected from the roadside data indicates that 58% of the 586 Rio Blanco interviews were from households residing in the same SCORP region as Rio Blanco County. Thirty percent of the total interviews in Gunnison County were from neighboring counties. These figures imply that a survey designed to sample recreation participation for a specific area should concentrate a higher proportion of the sampling in the areas adjacent to and including that area.

If the BLM is interested in estimating recreation participation in all counties containing significant amounts of Public Land, the statewide sample sizes determined from this study will not be sufficient unless the sample is allocated correctly among the regions. The propensity information specified in this study only delineates the propensities for Rio Blanco and Gunnison Counties. Propensity levels needed for other counties containing BLM land are not available. While the statewide sample sizes presented in this study are expected to produce recreation participation estimates close to the designated precision levels, the allocation of that sample size to specific origin regions may not provide data at the same accuracy levels. Most likely, the sampling levels in the key regions containing BLM lands would not be large enough to acquire the necessary sample of households visiting counties containing BLM lands to achieve the desired precision levels.

One method of coping with this problem would be to set minimum sampling levels in the regions containing BLM lands based on the similarity of that land to either Rio Blanco or Gunnison Counties. This technique would parallel the procedure outlined on page 159 which specifies

the determination of one sample size estimate from the estimates provided for each study area. If the BLM were to conduct their own statewide survey of dispersed recreation use, the proper allocation of the sample to the origin regions could be assured on the basis of expected recreation use on Public Land. Otherwise, a BLM recommendation specifying sample sizes for a statewide SCORP survey would include two figures delineating a minimum statewide sampling level and a required sampling level for certain regions. The major obstacle with this procedure is that a statewide SCORP demand survey cannot arbitrarily allocate a certain percentage of the total sample to a certain region without adjusting the total sample size or sacrificing the accuracy in other parts of the State. To maintain the randomness of the sample and guarantee each household an equal probability of selection, the total sample size would have to be adjusted to reflect the proper sampling proportions in each part of the State. Invariably this would lead to larger statewide sample sizes. This problem represents a major limitation for the applicability of the results of this study.

The fifth limitation focuses on the level of aggregation used to determine the total recreation use and sample size estimates. Two constraints limit the interpretation of the results for BLM planning and decision-making.

The first constraint is the decision to report the total recreation participation estimates at the county level of aggregation. Ideally, this study would estimate the total recreation use for all zones containing BLM land. This information would be useful, because the recreation could be pinpointed in specific areas instead of the general area of the county. The primary purpose for the county level of aggregation was that the

roadside interview locations were at county lines and interviewed people as they left the study areas. The principle component of calculating recreation use is the population of people visiting an area. The total population of traffic used to calculate the use estimates was determined by summing the traffic estimates from each interview station. To determine use for just one zone or area in the county, the total population of traffic visiting that area would have to be ascertained. There was no direct measure of that population value from traffic counters, visual observation, or historical data. Therefore, the estimated traffic visiting the county would have to be disaggregated to estimate the volumes visiting the appropriate zones. This would require a breakdown and reweighting of the total traffic estimates from each station to reflect the recreation participation in specific zones containing BLM land. Since the population of traffic leaving each study area was an estimate and there was no information specifying the accuracy of the estimate, further disaggregation of those data might lead to erroneous results. The weighting assigned to each station estimate would be difficult to determine, because there are no historical data from which to base a weighting scheme. The calculation of the numbers is feasible, but the realiability of the estimates would be suspect.

The second constraint focuses on a different component of the interpretation of the sample size estimates. Sample size estimates were based on the estimates of total recreation use in each study area. The principal variable was the total hours of recreation participation per vehicle. Since activity data were ignored during this procedure, the estimates do not reflect the degree of recreation participation in specific activities. The problem with estimating total recreation participation by activity

is the same as the first constraint. Specifically, the population of people participating in each activity is difficult to estimate. A second difficulty involves the estimation of the total hours of recreation participation in each activity. This information was not collected on the interview form. A complicated procedure would be necessary to decipher how much of the total recreation time was spent in each activity. While estimates of the total hours of recreation and the total number of recreationists participating in each activity would provide useful information, the problems encountered would reduce the reliability of the estimates and limit the application of the data for planning needs.

These limitations are discussed, not to discredit the sample size estimates, but to emphasize the importance of interpreting the sample sizes in the proper manner. The total recreation participation and sample size estimates presented in this study provide useful information from which decisions concerning the data needs and sampling design requirements of future surveys can be based.

CHAPTER IV. SUMMARY AND CONCLUSIONS

The primary purpose of this study was to provide ways to estimate sample size levels for future SCORP demand surveys which would produce recreation participation data from Colorado residents describing recreation use on BLM Public Land. Chapter II presents the methodology, while chapter III describes the analysis and results of a pilot test in Colorado. This chapter summarizes the structure of the methodology and the implications of this research for management.

Summary

A methodology was developed to estimate sample sizes for a future SCORP telephone survey in Colorado. Two survey techniques were used to isolate and measure different components of recreation participation in two study areas. A roadside traffic-stop survey at the study area boundaries stopped out-of-county vehicles (i.e., inter-county and out-of-state traffic) as they exited each study area during the summer recreation season. Information obtained was used to summarize the recreation participation of people living outside the study areas. The second sample survey technique measured in-county recreation participation of people living inside the study areas. This survey technique measured in-county recreation participation from a household survey during two one-week survey periods during the summer sampling period. From the results of each survey, a procedure was used to estimate the number of household interviews needed from a statewide household origin survey that sampled recreation participation for specific destination counties in Colorado which contain Public Land.

This procedure used two major analysis components to determine the final sample size estimates. The first component determined the sample size estimates from the roadside and household surveys. The roadside sample sizes set the sampling levels necessary in origin regions (excluding the study areas) for a statewide telephone survey which would produce recreation participation information in the destination study areas. The sampling levels to sample the residents of the study areas were calculated from the household survey data. Using a proportional equation, sampling levels in the destination counties were also determined from the roadside survey data. A comparison between the sampling levels from each survey indicated that the roadside survey analysis provided an adequate estimate of the sampling levels necessary in the two destination counties. Therefore, the roadside sampling levels determined for the origin regions were considered a reasonable estimate of the required levels. The sample size levels for the origin counties plus the estimates for each destination county produced one overall sample size level for each study area.

The second component of the methodology affecting the design of the final sample size estimation procedure was the two study area structure adopted for this study. Both surveys were conducted independently in two study areas to obtain the expected extremes (maximum and minimum) of variability associated with the dispersed recreation opportunities and the levels of dispersed recreation participation for all counties containing BLM land. Gunnison County was selected to represent an area of high diversity of recreation opportunities and high recreation use on Public Land, while Rio Blanco County portrayed a county with a high percentage of Public Land exhibiting low levels of dispersed recreation

use and opportunities. The sample size estimates calculated from the roadside and household surveys for Gunnison and Rio Blanco Counties defined the maximum and minimum levels necessary to sample recreation participation in any county in Colorado containing a significant amount of Public Land. The procedure for determining one sample size estimate for all counties containing BLM land requires that the BLM make a decision specifying the similarity between the recreation opportunities provided and recreation use occurring on those lands and the two study area counties. Once this decision is made, the necessary sample size level can be interpolated between the two extremes established by this research.

The analysis of the recreation participation data collected during the sampling period provides information which includes: (1) sample data summary statistics describing recreation participation in each study area; (2) estimates of total recreation use in each study area; and (3) sample size estimates for future surveys at designated levels of precision and confidence.

The sample data collected during each survey were analyzed to determine where, in what activities, and how long people were recreating in each study area. The results were summarized in tables by study area according to the survey technique used. These summary statistics are useful for defining the scope of recreation participation in each study area. Overall, Gunnison County exhibited higher levels and more diversity of recreation participation than Rio Blanco County.

The second output of the analysis was the estimation of the total recreation use in each study area. A statistical procedure incorporating a ratio estimator was used to transform the total hours of recreation

participation from each interviewed household into an estimate of the total hours of recreation participation for all households comprising the target population for each survey technique. This information was summarized in tables of the estimated total recreation participation (in hours and visitor days) and the levels of precision and confidence associated with each estimate. Since the accuracy levels of the participation estimates are useful for planning and management decisions, the precision and confidence levels were listed for each estimate. A comparison of the total use estimates for each study area revealed that the Gunnison data produced a better (i.e., more accurate) estimate of the total hours of recreation participation than the Rio Blanco sample data at the sampling levels of this study.

The sample size estimation procedure was the most important component of the analysis. The procedure used the total use estimates calculated from the sample data from each survey to develop sample size estimates for a statewide household telephone survey. Since the sample recreation participation data collected during the roadside and household surveys were not presumed to be the optimum data for describing recreation participation, the sample size estimates were presented at uniform levels of precision and confidence. This additional information enables the BLM to specify which sampling level would produce the best recreation participation data to meet their planning needs. Decisions which resource planners and managers must make before implementation of a statewide survey were outlined to show how data from this study can be useful and relevant.

Implications for Management

Two major implications of this research to BLM managers of wildland areas in Colorado are: (1) to acquire useful data for recreation planning on Public Lands from future SCORP demand surveys the BLM must determine their specific recreation participation data needs, and (2) the SCORP demand survey process might not be able to provide the optimum recreation participation information for the BLM's planning and management needs.

One of the major results of this study was the identification of the regional nature of recreation participation in each study area. A significant proportion of the total visits recorded during the roadside survey were from households residing in counties adjacent to the study areas. This regional recreation orientation has a major impact on the in-state sample size levels for future SCORP surveys which subsequently influence the quantity and quality of recreation participation information collected from visitors to the Public Land. Although a significant portion of the total visits to each study area originated in the same SCORP region as each study area, the population of these regions is a small proportion of the total population of Colorado. This indicates that a sample size allocation procedure based on the population size in the origin regions might not produce adequate recreation participation data from these key regions necessary to provice reliable information from visitors to the Public Land. This study recommends the establishment of a minimum sampling level in destination regions containing BLM land. The identification and quantification of the minimum regional sampling levels are based on the type of information needed by the BLM for recreation planning and management. Decisions, which BLM personnel

must make, concerning the type of recreation participation data needed by the BLM can be categorized into three areas: (1) identification of the important variables describing recreation participation on BLM land (i.e., total hours of recreation participation, total hours of recreation by activity, etc.); (2) desired levels of accuracy and confidence of the recreation data produced from a statewide survey; and (3) level of disaggregation necessary to provide useful information (regional, county, or site-specific levels). Once these decisions are made, the information needs of the BLM can be incorporated into the sample size results from this study to estimate the minimum regional sampling levels. With information about these levels the BLM can approach the State during the survey design to indicate the minimum sampling levels necessary to obtain data useful for BLM planning. At this time the State can indicate whether this information can be obtained under the constraints imposed by the survey design and budgetary considerations. The BLM will know before the survey is implemented whether the data will be useful or not for their needs.

The second major implication of this research indicates that the BLM might not be able to acquire the optimum level of recreation information from the SCORP demand survey process. Assuming that the BLM can specify the information that is needed and the minimum sampling levels in origin regions can be estimated, there are four major factors which can limit the ability of a SCORP demand survey to provide data at the optimum levels.

1. The first factor focuses on the ability of the State to implement a survey at the levels specified by the BLM. In this study the sample sizes were calculated based on one variable describing recreation

participation at the county level of aggregation. If the BLM were to select these sample sizes at reasonable accuracy and precision levels the statewide sample would be larger than those sample size levels used in the 1973 Colorado SCORP Demand Survey. Projecting the summer sample sizes determined in this study to the other three seasons would create an even larger sample size necessary to acquire information across all seasons. A conservative estimate would place the cost of this survey at four times the cost of the last SCORP survey in 1973 using a survey design similar to the one adopted in that study. The data acquired from a survey at those sampling levels would not reliably estimate recreation participation for individual activities or provide good information below the region or county levels of aggregation. Additional sources of funding might be necessary to implement a survey at the levels described above and would be required if more precise information is sought.

2. The data generated from a SCORP demand survey must serve the needs of other organizations besides the BLM. The State cannot design a survey based solely on the wishes of the BLM. The needs of all the organizations must be balanced to provide the most useful information for all parties concerned. This balancing process might alter the survey design which would influence the data generated from the survey. Therefore, the BLM might not receive reliable data at the optimum levels or even useful levels.

3. A future SCORP demand survey might not employ a survey design similar to the technique used in the last SCORP. In this case the minimum sampling levels presented by the BLM could not be applied to a different survey methodology. There would be no way of knowing how well

the new survey design would produce data to meet the needs of the BLM. A pilot study could be funded to acquire this information.

4. The statistical design, implementation, and analysis associated with a survey conducted at the level of a SCORP demand survey is a complicated and expensive process. Using this pilot study as an example, it is apparent that unanticipated problems can occur which influence the interpretation of the data. There is no guarantee that a SCORP survey implemented at the appropriate sampling levels would produce information at the desired levels of accuracy and precision. Many types of sampling and non-sampling errors can combine to limit the applicability of the results.

The factors listed above outline some of the reasons why the SCORP demand survey process might not be able to provide the optimum data for BLM planning needs. Regardless of the design, sampling levels, or expected accuracy of the results of a SCORP demand survey, these data should not be relied on to provide all the information describing recreation participation on Public Land. The BLM should explore other ways of acquiring recreation participation information.

The implications described above indicate two important considerations to the BLM pertaining to the recreation participation information acquired from SCORP demand surveys. The first implication implies that BLM personnel must take an active role in defining their information needs to the State before a survey is implemented. Although there is no absolute guarantee that this data can be collected, this information will enable the State to: (1) understand the recreation participation data needs of the BLM; (2) justify more funding based on agency needs for data in Colorado; (3) attempt to design a survey to collect some

useful data for the BLM. The second implication states that the SCORP demand survey process might not feasibly supply the optimum recreation participation data for BLM planning and management tasks. Reliable recreation participation information for specific recreation sites cannot practically be supplied by SCORP demand surveys. Based on the results of this study the sample sizes and total cost would be extremely large.

Irrespective of the type of information and results obtained from a SCORP demand survey, BLM planners and managers should be cognizant of the data limitations before using the information for resource allocation decisions. Each sampling design in this pilot study had limitations which influenced the interpretation and applicability of the results. If the limitations of the sampling design and subsequent effect on the data are not made available to the manager interpreting the data, conclusions based on an analysis of the data can be misleading. Before recreation participation data are used, the user must know the survey and sampling design of the survey, the estimation procedure, and accuracy of the estimates. With this information the manager can seek advice to identify the limitations of the data. Then, operating within the constraints imposed by the limitations, the data can be used to make planning and management decisions.

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APPENDIX A

ROADSIDE SURVEY QUESTIONNAIRE AND DECISION RULES

QUESTIONNAIRE (ROADSIDE SURVEY)

C1: 1 INTERVIEWER _____ IDENT _____ (75-80)

2 COUNTY: RIO BLANCO (1) GUNNISON (2)

3 STATION: _____ 7 TIME OF WEEK: WEEKDAY (1) WEEKEND (2) HOLIDAY (3)

4-6 DATE: _____ 8 TRIP PURPOSE: REC. (1) NON-REC. (2) TO-FROM REC. (3)

9-11 TOTAL TIME SPENT IN AREA _____ HOURS

TIME SPENT IN AREA (HRS.):

A	B	C	D	E	F	G
12-14	15-17	18-20	21-23	24-26	27-29	30-32

ACTIVITY		ZONES					ACTIVITY		ZONES				
1) BOATING-LAKE	36-40						11) COLLECTING	16-20					
2) BOATING-RIVER	41-45						12) HIKING/WALKING	21-25					
3) CAMPING NEAR AUTO	46-50						13) TECHNICAL MT. CLIMBING	26-30					
4) CAMPING AWAY FROM AUTO	51-55						14) HORSEBACK RIDING	31-35					
5) FISHING	56-60						15) HUNTING	36-40					
6) PICNICKING	61-65						16) WILDLIFE VIEWING	41-45					
7) SIGHTSEEING - DRIVING	66-70 / 74(1)						17) PHOTOGRAPHY	46-50					
8) 4-WHEEL DRIVING	ID. 75-80 / C2: 1-5						18) NATURE STUDY	51-55					
9) MOTORCYCLING	6-10						19) OTHER	56-60					
10) BICYCLING	11-15							74(2) ID. 75-80					

C3: 1-2 WHICH ACTIVITY WAS MOST IMPORTANT TO YOU AS A REASON FOR VISITING THIS AREA (ABOVE #): _____

3 DID YOU ENTER EITHER OF THE FOLLOWING:
POWDERHORN PRIMITIVE AREA (1) _____ WEST ELK WILDERNESS AREA (2) _____

4 APPROXIMATELY HOW MANY MILES DID YOU DRIVE THIS VEHICLE ON UNPAVED ROADS:
NONE (1) <10 (2) 10-25 (3) >25 (4)

5-6 HOME COUNTY _____ #_____ 7-8 STATE _____ #_____

9-13 ZIP CODE _____

14 TYPE OF VEHICLE: CAR (1) TRUCK (2) VAN (3) CAMPER (4) MOTOR HOME (5)
MOTORCYCLE (6) JEEP (7) OTHER (8) _____

15 TRAILER TYPE: UTILITY TRAILER (1) CAMPER TRAILER (2)

16 AXLE TYPE: 2 X 4 (1) 4 X 4 (2)

17-18 TOTAL # OF PEOPLE IN HOUSEHOLD PRESENT _____

-15		16-20		21-45		+45	
M	F	M	F	M	F	M	F
19	20	21	22	23	24	25	26

27-28 TIME OF DAY _____

74 (3) ~~#~~ people/household _____

75-80 IDENT

SMILE

DECISION RULES (ROADSIDE QUESTIONNAIRE)

Person to interview:

We are interested in the recreational activities from people in a single household. If more than one household is represented in one vehicle, only interview one household. Interview an adult member of the household. (16 or older)

General:

Identify yourself as a C.S.U. student involved in a research project to identify the activities of recreationists. Ask them if they would be willing to help us by answering some questions on their recreational activities. (couple or few minutes) Our only tie with the BLM is that they are interested in the data.

County: circle one

Station: Enter the letter used to designate interview station on your map.

Date: Enter month and day--when day is a single digit, enter a 0 before the day. ex. July 12=712, July 1=701.

Trip Purpose: Ask the person if the purpose of their trip was recreation. If the interviewee has been engaging in recreation anywhere in the study area, circle REC and continue interview. If the purpose of the trip was recreation but the location was not in the study area, circle to-from rec; thank individual and discontinue

the interview. If the trip was not for recreational purposes, circle NON-REC; thank the individual and discontinue interview.

Total hours spent and time spent in area:

Indicate the total number of hours spent in the study area as part of his or her recreation trip. Question the person further about the time spent in each zone. Road travel time will not be included unless person indicates that they were (sightseeing-DRIVING). Some form of recreation must have occurred if time is to be logged. ***All recreational activity times should be rounded off to the nearest hour (except sightseeing) and must be participated in at least for 1/2 hour. If a person has indicated auto driving the interviewer should mark all time from 0-30 minutes as .5 on sheet and all time over 30 minutes as 1. All time beyond 1 hour will be rounded to the nearest hour.

Activities:

(check as person indicates what he/she has done)

Question the interviewer to determine the activities and locations of his/her recreation. For each activity participated in, indicate in the boxes from left to right the zones (letters) representing the areas in which recreation occurred.

Activity Definitions:

Camping near auto--Approximately 100 yards or less from auto or campground: All else will be camping away from auto.

4-wheel--must have actually used the four wheel.

Collecting--Examples-gathering mushrooms, antlers, rocks, arrowheads, artifacts, plants, animals, gold. Interviewee may be reluctant on this question. If he/she stumbles, inform him/her that we are not interested in what he collected-just if it was done.

Technical mtn. climbing--check if person used appropriate equipment.

Wildlife viewing--and--nature study--should distinguish between, by separating wildlife from nature study.

Other--check other if activity mentioned is not listed. Write down name of others and indicate in field notebook and in the interview form.

Most important activity:
From the interviewee determine the activity most important in coming to the area. Have the person make a decision and place a number on the line according to the numbers next to the activities above.

Enter primitive or wilderness area: For Gunnison county only (check if either or both are entered).

Approximately how many miles: Circle the correct range in which their miles driven falls.

Home county: write down county; then, immediately after interview or that night fill in the number the county is on the handout.

Home state: same as above.

Zip code: fill in numbers. If questioned, indicate that we sometimes like to see of recreationists are coming from the same city or area within each county.

Axle type: circle appropriate one. Watch for 4-wheel drive cars, etc.

Total # of people in house-hold present:
Put in the number of people which are present in vehicle and are also members of the same household. Two non-married people living together also constitute a household. If a household becomes hard to define, just think in terms of people living at the same phone number.

Total # of people in household: This is the total number of people living as a member of the household, even if they are not present at the interview site.

Time of day: Enter hour you began the interview. Put 0 in front of single digit hours (1-9).

NOTEBOOK

- 1 interview location/sheet of paper

Station _____ Date _____

Length of interview period (nearest 1/4 hr.) _____

# of households interviewed _____

# of cars

-other county license tags _____

-out of state _____

-non sampled (in county, gov't, commercial) _____

Counters

count _____ time _____
(write in either working or not-working)

# of non-responses _____
(i.e. those who refuse to participate)

Other counter locations checked (name of location)

date _____

time _____

count _____
(working or not-working)

Comments _____

_____ etc.

APPENDIX B

ROADSIDE SURVEY EXAMPLE CALCULATIONS

POPULATION MEAN AND VARIANCE ESTIMATES FOR ONE STATION
(Example calculations - Rangley)

1. Estimation of total traffic (Example calculations for one sampled day) 6/17/77.

Counters - 9:00 a.m. 6/17 - 22213
9:00 a.m. 6/18 - 23590

23590-22213=1377 (total clicks on the counter)

Estimated truck/car ratio this station - 1/8

Trucks click counters 1.5 times more than cars

1377 ÷ 8 = 172, 172 x 1.5 = 258 (added clicks by trucks)
1377 - 258 = 1119 (estimated total traffic)

2. Adjustment calculations, three hour interview period to one day (Example for 6/17/77 continued).

Sample statistics - 6/17 (9-12 interview period)

226 total traffic

of which - 122 (trucks, commercial, in-county vehicles, not eligible for the survey)

- 124 (out-of-county, out-of-state, eligible for survey)

124 ÷ 226 (x 100) = 55% (percent of traffic during interview period that was eligible for the survey)

30 interviews

.8 (mean total hours of recreation participation per interviewed vehicle)

Adjusting to one day total

1119 total vehicles (from above)

1119 x 55% = 615 (estimated total vehicles that was eligible for the survey)

615 x .8 = 492 (estimated total hours of recreation participation from that station on 6/17)

3. Estimated totals from all interviewed days at the Rangley station.

Interview Period	Date	Estimated Eligible Traffic	Sample Mean	Estimated Total Hours
1	6/17	615	.8	492
2	6/18	634	1.8182	1,153
3	7/2	349	1.12	390
4	7/3	468	3.46	1,619
5	7/18	585	0.0	0
6	8/25	317	.4706	149
7	8/26	337	.1379	46

4. Population mean and variance estimates (Rangley station).

Equations

a. Mean

$$\hat{\bar{\bar{Y}}}_{ir} = \sum_{j=1}^{n_i} M_{ij}\,\bar{y}_{ij} \Big/ \sum_{j=1}^{n_i} M_{ij} \qquad [2.3]$$

b. Variance

$$\hat{V}(\hat{\bar{\bar{Y}}}_{ir}) = \frac{1-\delta_i}{n_i \bar{M}_i^2}\left(\frac{\sum_{j=1}^{n_i} M_{ij}^2 (\bar{y}_{ij}-\hat{\bar{\bar{Y}}}_{ir})^2}{n_i-1}\right) + \frac{\delta_i}{n_i^2 \bar{M}_i^2}\left(\sum_{j=1}^{n_i} \frac{M_{ij}^2 (1-\delta_{ij}) s_{ij}^2}{m_{ij}}\right) \qquad [2.4]$$

where: $\delta_i = n_i / N$, $\bar{M}_i = M_{i0}/N$, $\delta_{ij} = m_{ij}/M_{ij}$

N = total number of days in the summer sampling period

n_i = number of sampled days at the i^{th} station

M_{i0} = total traffic estimate at the i^{th} station for the whole summer

M_{ij} = total traffic estimate at the i^{th} station on the j^{th} sampled day

m_{ij} = sample size at the i^{th} station on the j^{th} day

$\overline{y}_{ij}$ = mean total hours of recreation per vehicle at the i^{th} station on the j^{th} day

s_{ij}^2 = variance for the mean total hours of recreation per vehicle at the i^{th} station on the j^{th} day

$\hat{\overline{Y}}_{ir}$ = mean total hours of recreation per vehicle at the i^{th} station for all sampled days using a ratio estimator

$\hat{V}(\hat{\overline{Y}}_{ir})$ = variance for the i^{th} station mean estimate

Calculations (interview periods 1-7)

M_{ij} = (1) 615, (2) 634, (3) 340, (4) 468, (5) 585, (6) 317, (7) 337

M_{ij}^2 = (1) 378225, (2) 401956, (3) 121801, (4) 219024, (5) 342225, (6) 100489, (7) 113569

n_i = 7, n_i^2 = 49, N = 77

$\overline{M}_i = \left(\sum_{j=1}^{n_i} M_{ij}\right) / n_i$ = 472, $\overline{M}_i^2$ = 222784

M_{i0} = $\overline{M}_i$ x 77 = 36355

s_{ij}^2 = (1) 4.9, (2) 73, (3) 46.6, (4) 305.5, (5) 0, (6) 3.4, (7) .55

f_i = n_i / N = 7/77 = .09

$f_i / (n_i^2 \overline{M}_i^2)$ = .000000008

$1 - f_i / (n_i \overline{M}_i^2)$ = .00000058

m_{ij} = (1) 30, (2) 33, (3) 50, (4) 50, (5) 43, (6) 34, (7) 29

f_{ij} = m_{ij} / M_{ij} = (1) .05, (2) .05, (3) .14, (4) .11, (5) .07, (6) .11, (7) .09

$1-\delta_{ij}$ = (1) .95, (2) .95, (3) .86, (4) .89, (5) .93, (6) .89, (7) .91

Mean $(\hat{\bar{Y}}_{ir}) = \frac{(492 + 1153 + 390 + 1619 + 0 + 149 + 46)}{(615 + 634 + 349 + 468 + 585 + 317 + 337)} = \frac{3849}{3305} = 1.16$ hrs

Variance $\hat{V}(\hat{\bar{Y}}_{ir}) = \frac{[(.00000058)(49018 + 164641 + 195 + 1158636 + 460498 + 56978 + 118644)]}{6}$

$+ [(.000000008)(58688 + 844716 + 97626 + 1191031 + 0 + 8944 + 1960)]$

$= (.00000058)(334768) + (.000000008)(2202964)$

$= .212$ hours

APPENDIX C

HOUSEHOLD SURVEY QUESTIONNAIRE, INFORMATION SHEET, AND DECISION RULES

QUESTIONNAIRE (HOUSEHOLD SURVEY)

C1: 1 INTERVIEWER_____ IDENT_____ (75-80)

2 COUNTY: RIO BLANCO(1) GUNNISON(2) 6-12 PHONE #: _____

3-5 DATE:_____ 13-14 TIME OF DAY: _____

15 TIME OF WEEK: WEEKDAY(1) WEEKEND(2) HOLIDAY(3)

16 # OF DIFFERENT TELEPHONE #s AT YOUR RESIDENCE_____

18-19 TOTAL # OF PEOPLE LIVING IN YOUR HOUSEHOLD_____

20 RECREATION PARTICIPATION: YES(1) NO(2)

ACTIVITY		ZONES				
1) BOATING-LAKE	21-25					
2) BOATING-RIVER	26-30					
3) CAMPING NEAR AUTO	31-35					
4) CAMPING AWAY FROM AUTO	36-40					
5) FISHING	41-45					
6) PICKNICKING	46-50					
7) SIGHTSEEING-DRIVING	51-55					
8) 4-WHEEL DRIVING	56-60					
9) MOTORCYCLING	61-65					
10) BICYCLING	66-70 74(1)					
11) COLLECTING	ID. 75-80 C2: 1-5					
12) HIKING / WALKING	6-10					
13) TECHNICAL MTN. CLIMBING	11-15					
14) HORSEBACK RIDING	16-20					
15) HUNTING	21-25					
16) WILDLIFE VIEWING	26-30					
17) PHOTOGRAPHY	31-35					
18) NATURE STUDY	36-40					
19) OTHER	41-45					
20)						
21)						
22)						

63 DID YOU ENTER EITHER: POWDERHORN PRIMITIVE AREA(1) WEST ELK WILDERNESS AREA(2)

64-65 TOTAL # OF PEOPLE WHO PARTICIPATED IN ANY RECREATIONAL ACTIVITY FROM HOUSEHOLD_____

-15		16-20		21-45		+45	
M	F	M	F	M	F	M	F
66	67	68	69	70	71	72	73

74(2)

75-80 Ident

C3: 1-2 HOME COUNTY_____ #_____ 3-4 STATE_____ #_____

5-9 ZIP CODE_____

10 PERSON INTERVIEWED: FATHER(1) MOTHER(2) DEPENDENT(3) EQUAL STATUS(4)

QUESTIONNAIRE (HOUSEHOLD SURVEY, CONT.)

TRIP 1

11-12 TOTAL # OF HOUSEHOLD MEMBERS ON TRIP_____

13-15 TOTAL REC. TIME ON TRIP_____ (HRS)

TIME SPENT IN EACH ZONE: (HRS)

A	B	C	D	E	F	G
_____	_____	_____	_____	_____	_____	_____
16-18	19-21	22-24	25-27	28-30	31-33	34-36

TRIP 2

41-42 TOTAL # OF HOUSEHOLD MEMBERS ON TRIP_____

43-45 TOTAL REC. TIME ON TRIP_____ (HRS)

TIME SPENT IN EACH ZONE: (HRS)

A	B	C	D	E	F	G
_____	_____	_____	_____	_____	_____	_____
46-48	49-51	52-54	55-57	58-60	61-63	64-66

74(3) IDENT 75-80

TRIP 3

C4: 1-2 TOTAL # OF HOUSEHOLD MEMBERS ON TRIP_____

3-5 TOTAL REC. TIME ON TRIP_____ (HRS)

TIME SPENT IN EACH ZONE: (HRS)

A	B	C	D	E	F	G
_____	_____	_____	_____	_____	_____	_____
6-8	9-11	12-14	15-17	18-20	21-23	24-26

TRIP 4

31-32 TOTAL # OF HOUSEHOLD MEMBERS ON TRIP_____

33-35 TOTAL REC. TIME ON TRIP_____ (HRS)

TIME SPENT IN EACH ZONE: (HRS)

A	B	C	D	E	F	G
_____	_____	_____	_____	_____	_____	_____
36-38	39-41	42-44	45-47	48-50	51-53	54-56

74(4) IDENT 75-80

TRIP 5

C5: 1-2 TOTAL # OF HOUSEHOLD MEMBERS ON TRIP_____

3-5 TOTAL REC. TIME ON TRIP_____ (HRS)

TIME SPENT IN EACH ZONE: (HRS)

A	B	C	D	E	F	G
_____	_____	_____	_____	_____	_____	_____
6-8	9-11	12-14	15-17	18-20	21-23	24-26

31-33 TOTAL REC. HRS.FOR HOUSEHOLD_____ (TOTAL MEMBERS/TRIP) X (TOTAL REC. TIME/TRIP)
(FIND ABOVE VALUE FOR ALL TRIPS AND SUM TO GET TOT.)

74 (5) IDENT 75-80

INFORMATION SHEET

Interviewer: _____ Telephone Number: _____

County: _____

Results: (check one)	First Call	Second Call	Third Call
1) Non-working #			
Recorded Message			
Non Connection			
2) Unanswered rings			
3) Working #			
Non-household			
Household			
Busy signal			
Wrong connection (different # than dialed)			
Household (wrong county)			
No one home ≥ 16			
Date			
Time			

Rec _____

No Rec _____

Non-response _____

Never reached _____

Length of Interview (nearest minute) _____

Comments (interviewer):

DECISION RULES (HOUSEHOLD QUESTIONNAIRE)

The first two pages of the questionnaire are to be filled out only after a household has been contacted and the interviewee has agreed to participate. We are interested in all outdoor recreation activities from a household (everyone) in the last two weeks.

Interviewer: Your initials

County: Circle appropriate one

Phone #: Write down # of person contacted after verifying that the phone # you dialed is the one you reached.

Date: Just month and day. Put in a "0" if the day is a single digit #. (Ex. - July 3 = 703)

Time of Day: Use a military hour designation. (24 hr. system) Put "0" before any single digit #. Only record hours and round to the nearest hour. (Ex. - 6 o'clock at night is 18; 9 in the morning is 09)

Time of Week: Circle appropriate day.

# of Different. . . Ask the interviewee how many telephone #'s they have at their residence (home). We are not interested in extensions. Just different #'s. If they mention a business phone do not include it in total. Most people have just one.

Total # of People . . . # of people who are living at residence called.

Recreation Participation: If the person has participated in an outdoor recreational activity in Rio Blanco/Gunnison county within the last two weeks (our designated dates) circle "yes". Otherwise, circle "no".

(If "no" was circled, thank person for their time, discontinue interview, and fill out the information sheet.)

Activities: When activities are indicated, determine the area of participation and locate within a zone on the map. Record the zone letter next to the activity in the far left space. If more than one zone is used then record the letters in up to five zones to the right of the activity.

While interviewing for activities and hours, it might be helpful to have questionnaire pages one and two next to each other. We are asking the interviewee to recall the outdoor rec. activities of the entire household for the past two weeks. In order to obtain a value for total household hrs., we need to isolate each trip, determine # of participants/trip, and hours/zone for that trip. The interviewer should be responsive to the technique that works best for them. It might be useful to work on a trip basis if the household has participated at different times. Then activities can be recorded as the interviewee is recalling each trip. An activity that was participated in a zone twice, should only be recorded once in the activity section. (Ex. - If household #1 with members A,B,C were called, if A answers he might reply: On Tuesday, B and I went out and caught flies on Toad

Pond. On Friday, the whole family watched the drunks and caught flies at the dump. If the dump and the pond were both in zone A, then the interviewer would fill out the form as follows: in activity slots 19 and 20, watching drunks and catching flies would be recorded with zone "A" indicated in the first zone slot to the right. Two trips would be indicated with 2 persons on one and 3 persons on the other. All hours would be recorded in zone A and total hrs. would be recorded in the proper slot.) The activity list should not be spewed off in 18 consecutive activities. A few should be mentioned to stimulate thinking along the proper lines. If the person sounds indecisive you might mention some other activities, etc. The first set should vary some as you progress from one interview to the next. Mentioning activities on the phone to the respondent is done to get him to think along the right lines.

Did You Enter. . . Only ask this for Gunnison County recreators.

Total # of People: Ask them or determine total # of people who participated in any recreational activity recorded above during the last two weeks.

Age Chart: Ask them about family ages and record appropriate # under correct heading.

Home County and State: Should be recorded for each interview, although primary emphasis is placed on recording for summer home people. (Home county is not necessary for out of state people, only in state.)

Zip Code: Put in directly.

Interviewee: Determine who you are talking to. If interviewee considers him/herself other than father, mother, or dependant, record as equal status. (Equal status could be housemates, people living together, married people, etc. Depends on their answer.)

Bottom of Page 2 -

Total Recreation Hours for Household: In this space we want the cumulative total of all rec. hrs. for the individual household. At the end of each interview, please use the equation at the right to determine a trip figure. Sum the values for all trips and record in the space at the bottom of the page. (Ex. - Just multiply the values in the first two spaces for each trip.) In the preceeding example, if total hrs. during the first trip was 20 and 10 for the second trip, multiply 2 people x 3 people x 10 hrs. and sum up. 70 would be recorded at the bottom of the page.

Sample Interview

(If the person you are talking to is obviously under 16, by the way they answer the phone, then ask if their mother or father is home. In most cases, you should go through the introduction. We would like to speak to a mother or father or dependent child 16 or older. If no one in this category is there, than inform them you'll call back.)

Introduction:

Hello, my name is _____. I am a student at Colorado State University. The university is working with managers of public lands in Rio Blanco/Gunnison county to determine what types of outdoor recreation facilities should be developed in Rio Blanco/Gunnison county. As a part of that study, we are telephoning a random sample of the residents of your county to find out what their outdoor recreation preferences are. If we promise to protect your privacy by not relating your name or address to your answers, could you take 4-5 minutes to help us with this study?

If no, thank them for their time and discontinue interview. Fill out first page of questionnaire down to "time of week". Try to have determined whether you have been speaking to the father, mother, dependent, or equal status person. Remember to fill out as non-response on page 3. Put down reason for non-response under comments, if reason given.

If yes, proceed with questionnaire. (Ask them if they are a resident of Rio Blanco/Gunnison county.) If not thank them and mark on page 3. If they are summer residents only, you should proceed with interview.

Going on: (Make sure that you are speaking to a father, mother or dependent over 16. Preferably father or mother if they are home.

-The phone number I dialed was _ _ _ _ _ _ _. Is this your number? (If yes fill in questionnaire.)

-Do you have more than one telephone # that services your home? If yes, ask them how many are non-business phones. Don't include business #'s. Most people will only have one phone #.

-How many people live in your household?

-Between Monday, July 18 and Sunday, July 31 did you or any members of your household participate in any outdoor recreation activities?

-The kinds of outdoor recreation activities we're interested in include: camping, boating, hunting, photography, etc.

- - - - - - - - - - - - -

(Try to have person think of activities on the basis of a single trip, if they do this we can then record the hours and # of people from household. This is the critical information.)

-In order to get information about zones for the activities, you will need to have them identify where they went. You should locate area on map and record proper zone. Remember they do

not know what or where our zones are.

-When filling in hours, just round their recreation time to the nearest hour. Don't deal in partial hours.

**If they seem to stumble when thinking of appropriate activities, you can give some more examples of what we want. For some people you may have to read almost the whole list.

APPENDIX D

HOUSEHOLD SURVEY MEANS AND VARIANCES BASED ON ONE TRIP PER HOUSEHOLD

Table 55. Sample adjusted means and variances for each survey in both study areas (Household survey, summer 1977).

County	Survey[a]	Mean[b]	Variance[c]
Rio Blanco	1	11.599	440.207
Rio Blanco	2	9.834	407.064
Gunnison	1	29.121	2,554.734
Gunnison	2	24.899	1,292.112

[a]Survey 1 sampled recreation participation between July 18 and July 31. Survey 2 sampled recreation participation between August 23 and September 5.

[b]Mean number of hours of total recreation per household per trip.

[c]Variance for the mean.

Table 56. Adjusted population mean and variance estimates for both study areas (Household survey, summer 1977).

County	Units[a]	Mean[b]	Variance[c]
Rio Blanco	hours	10.72	1.59
Rio Blanco	visitor days	.893	.011
Gunnison	hours	27.01	6.46
Gunnison	visitor days	2.25	.045

[a]One visitor day equals 12 hours.

[b]Adjusted population mean estimate.

[c]Variance for the mean estimate.